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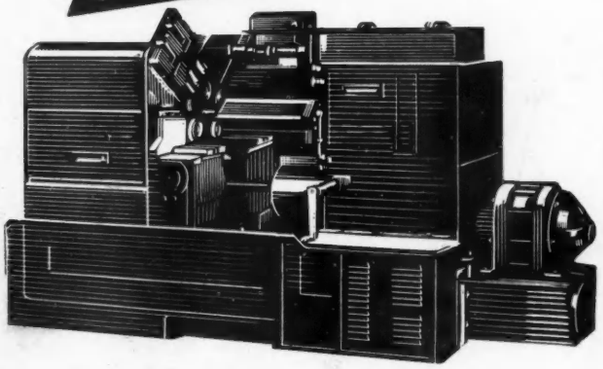

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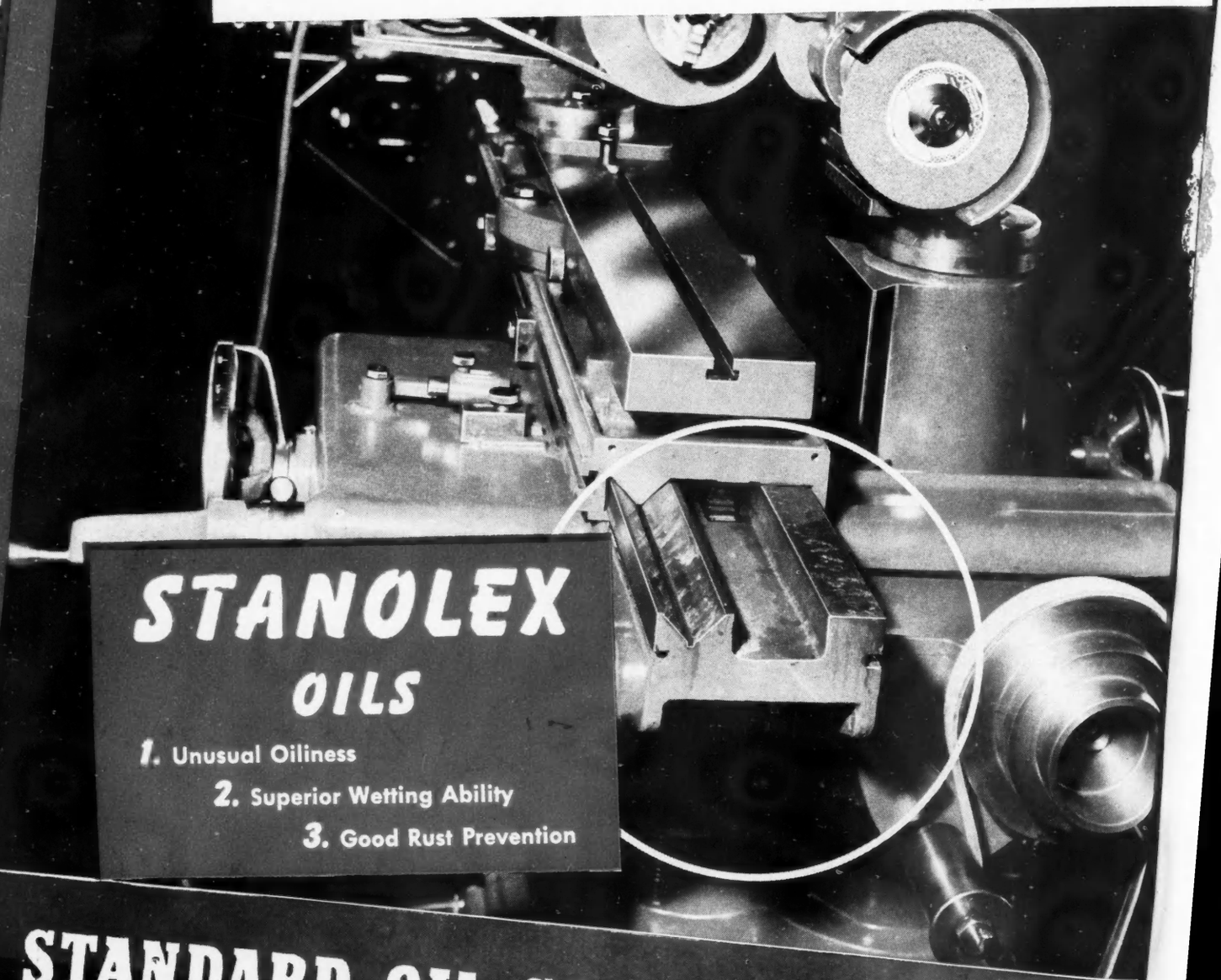

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AUTOMOTIVE and Aviation INDUSTRIES

Published Semi-Monthly

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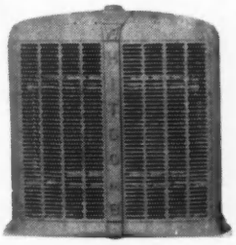

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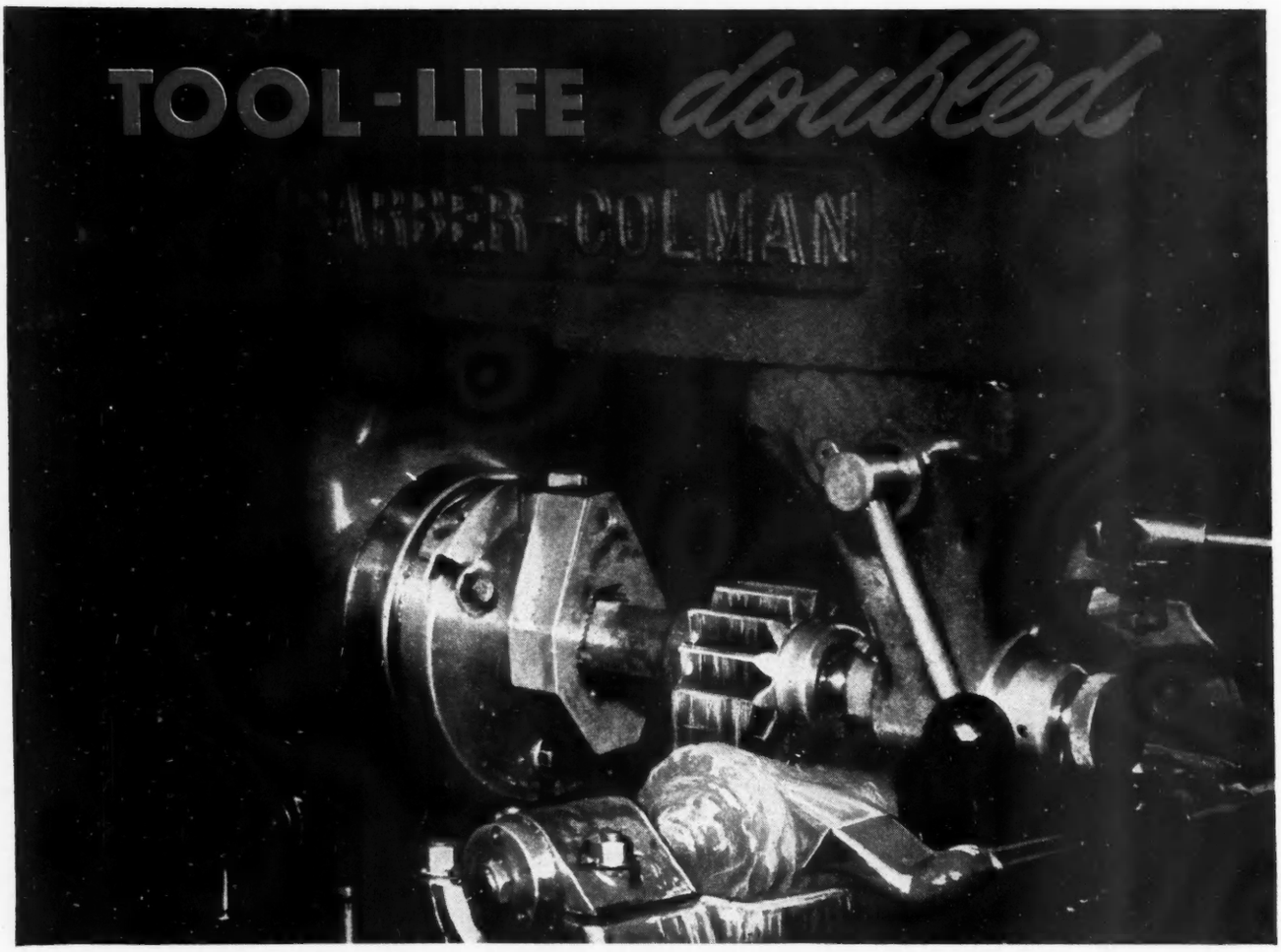

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IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 86 June 1, 1942 Number 11

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

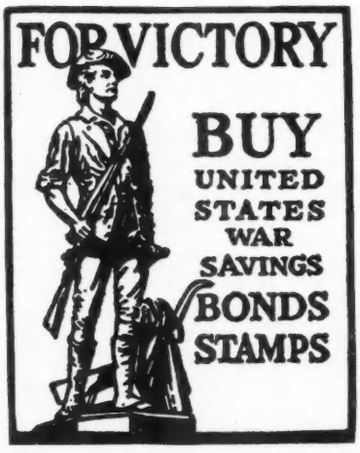
Eleven Million Cars Short Of Fuel on Seaboard

More than 11,000,000 motor vehicles, 140,000 retail gasoline outlets, and upwards of 1,500,000 oil burners in homes, are affected by the shortage of petroleum transportation to the East Coast, compilations in the April issue of the American Petroleum Institute "Quarterly" reveal.

This populous industrial region, embracing 17 States and the District of Columbia, has 36 per cent of all the motor vehicles operating in the United States, and 63 per cent of all the domestic oil burners. About 34 per cent of the country's retail gasoline outlets, including 82,000 service stations and 59,000 other stores with gasoline pumps, are in the shortage area.

A total of 12,190,000 passenger cars, trucks, and buses were registered in the East Coast area during 1941, but scrappings during the year reduced the number operating on Jan. 1, 1942, to 11,279,000, the article estimates. These included about 62,000 revenue and school buses, 1,434,000 trucks, and 9,783,000 passenger cars.

Gasoline consumption normally accounts for 40 per cent of the total demand for petroleum products on the East Coast, but motor vehicle operators, particularly passenger car owners, must expect to lose more than their proportionate share to help meet the overall shortage of petroleum transportation.



As Gas Goes—So Go Tax Revenues 17

With the loss of revenue from gasoline sales, the federal government and the several states must look for new means of income. Here is an account of just how much this source of income has meant and how much will have to be raised from other sources.

Buick's Warplane Engine Plant 20

Within a period of less than ten months after Buick went over to aircraft engine production in the war program, engines were rolling off the line. It is a real story. Read it.

Powder Metallurgy 28

The rapid expansion and the importance of powder metallurgy in the war program is the subject treated in this article. Although in the research stage for many years only recently has it really come into its own. You must read this to be up-to-date on this new method that is changing production programs.

How Chrysler Rebuilt 44 Old Machines 32

If they cannot get what they want at the Chrysler plant they improvise and use what they have. Some fellows there. You will enjoy this and admire them.

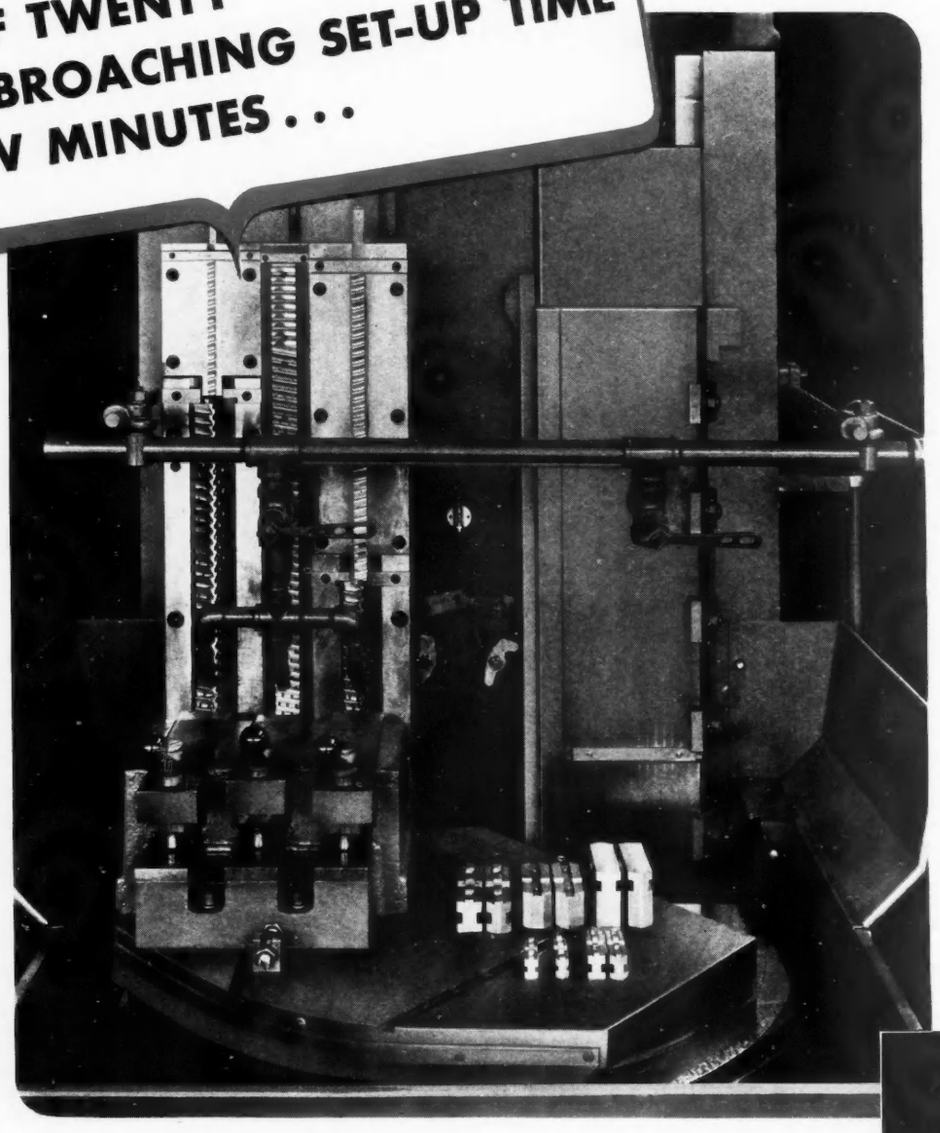
Test of a Magnesium Alloy Wing 36

New things are being done in these days to make things better and to make them faster. The Dow Chemical Co. has been doing some work toward that end that may well be a big contribution to the industry.

The Strain Gage as an Aid in Aircraft Design 40

Here is an interesting development that is becoming the tool of aircraft structural designers. It is explained in this article. Replete with graphs and other illustrations.

FAMILY OF TWENTY REDUCES BROACHING SET-UP TIME TO A FEW MINUTES . . .



ONE of the chief difficulties in using the rapid broaching process for machining a variety of short runs is the relatively large amount of set-up time ordinarily required to change from one part to another. This objection can readily be eliminated if a group of parts requiring surface finishing have the same family characteristics.

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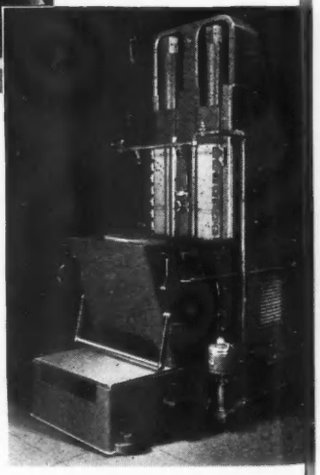

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AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

Vol. 86, No. 11
June 1, 1942

As Gas Goes—

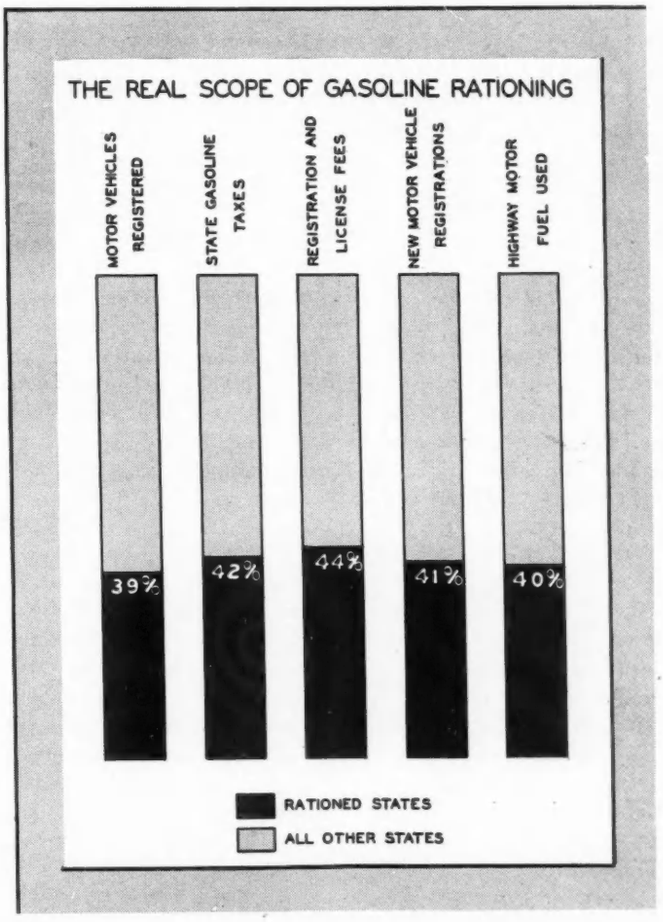
So Go Tax Revenues

By Marcus Ainsworth

IN THE 17 States along the Atlantic seaboard, the District of Columbia, and Washington and Oregon on the West Coast, there will be a drop of more than $140,000,000 in tax revenue from the sale of gasoline alone during 1942, compared with the revenue received from that source during 1941. This estimate is based on the assumption that the present curtailment of gasoline deliveries to retail outlets of 50 per cent of the average for December, January, and February, adjusted for seasonal influences, will continue.

Up to March 16 of this year, there was no authorized curtailment of deliveries of gasoline to retail outlets, but on that date a 20 per cent reduction in gallonage in the 19 States was made and on April 16 a further cut to 33 1/3 per cent went into effect. On May 16 a further cut to 50 per cent was made. In estimating the State gasoline tax revenue for 1942 for those States in the curtailed area these facts have been taken into consideration. With 1941 as a base, full revenue was assumed for the first three months of 1942, a 20 per cent reduction was estimated for the fourth month, a cut of one-third for the fifth month, and of 50 per cent for the remaining seven months.

If this last cut is continued for the remainder of the year, the overall percentage loss in tax revenue during 1942, as compared with 1941, will be 35.8 per cent or $141,580,000. It may be more than that for the rationing plan which has been put into operation in the eastern States will undoubtedly cut the gallonage of many car operators more than 50 per cent, possibly as much as 75 per cent, and cause many car owners to stop driving altogether.



While it is impossible to forecast at this time just how much gasoline the automobile owner will get six months from now, it appears in the light of present happenings, that we can safely assume that the current 50 per cent deliveries to retail outlets will not be the minimum and that when more experience with rationing has been had a further cut is quite probable. If this should turn out to be the case the 19 States and the District of Columbia will suffer even greater losses of

tax revenue than the presently estimated $141,580,000.

These 19 States and the District of Columbia during 1941 accounted for about 42 per cent of the revenue received by all States from gasoline tax collections. They comprise the States of Connecticut, Delaware, Florida, Georgia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, South Carolina, Vermont, Virginia, Washington and West Virginia and the District of Columbia. Throughout this area during the past year, gasoline State tax collections amounted to $396,564,000. The maximum amount that may be received during 1942, estimated on the basis of present cuts, is $254,984,000, a decline in revenue which, if our law makers run true to form, is not likely to be met by a corresponding reduction in governmental expenses.

Ensuing decreases in State revenue resulting from reduced registration fees also seem inevitable. During 1941 there was collected $463,517,000 in registration and license fees throughout the entire country. Of this amount $203,546,000 or 44 per cent was derived from the States in the curtailed area. With the complete stoppage of passenger car production and truck production reduced to the requirements of the Federal Government, a large potential source of revenue was immediately wiped out. Cessation of production means no new registrations other than the insignificant few which are released from present stocks by the ration boards throughout the country. While this reduction in registration fees of new motor vehicles applies to all States it is a harder blow to those States in the gasoline rationing affected area, as during 1941 these 19 States and the District of Columbia accounted for 41 per cent of all new motor vehicle registrations.

From gasoline taxes alone New York State will show a decline in 1942 over 1941 of about $26 million, Pennsylvania $22 million, Florida $10 million, Virginia $8 million and so on down the list to Vermont with a decline of $1 million. State gasoline collections in the affected rationing area during 1941 with the estimated collections during 1942 and the resulting losses in revenue are given in Table A. The effect of exemption of certain counties in three of the rationed States will, in all probability, be offset by the conservativeness of the overall estimate, herein.

To some of the States in the rationing area this loss in revenue from gasoline taxes might not be much of a hardship and it is possible that increase in returns from other types of taxes will more than offset this loss. However, there are other States that have built up their tax collections largely at the expense of the motor vehicle owner. These States will be most severely hit. Florida is the leader in this respect as its revenue from motor vehicles in the form of gasoline taxes, registration and license fees amounted to 54.1 per cent of its total State tax collections during 1940. Oregon obtained 50.2 per cent of its total revenue from motor vehicles, Georgia, 46.3 per cent, Vermont, 45.5 per cent. The average for the country was 29.6 per cent, which shows the extent to which motor vehicle taxes have been diverted from the purposes for which their original advocates assured us they were intended.

TABLE A

	Total State Gasoline Taxes 1941	Estimated State Gasoline Taxes for 1942	1942 Estimated Loss in Gasoline Tax Revenue from 1941
Connecticut	$11,801,000	$7,586,000	$4,215,000
Delaware	2,750,000	1,767,000	983,000
Dist. of Col.	3,153,000	2,027,000	1,126,000
Florida	27,400,000	17,618,000	9,782,000
Georgia	23,000,000	14,788,000	8,212,000
Maine	6,664,000	4,284,000	2,380,000
Marvland	13,070,000	8,404,000	4,666,000
Massachusetts	22,768,000	14,641,000	8,127,000
New Hampshire	3,716,000	2,389,000	1,327,000
New Jersey	24,800,000	15,946,000	8,854,000
New York	74,458,000	47,876,000	26,582,000
North Carolina	28,664,000	18,431,000	10,233,000
Oregon	14,713,000	9,461,000	5,252,000
Pennsylvania	63,000,000	40,508,000	22,492,000
Rhode Island	4,272,000	2,747,000	1,525,000
South Carolina	15,815,000	10,169,000	5,646,000
Vermont	2,935,000	1,886,000	1,049,000
Virginia	23,265,000	14,959,000	8,306,000
Washington	19,320,000	12,423,000	6,897,000
West Virginia	11,000,000	7,074,000	3,926,000
	$396,564,000	$254,984,000	$141,580,000

In the great majority of States the motor vehicle fuel tax was originally inaugurated for the purpose of building and maintaining adequate highway systems. During recent years the revenue from this tax has been allocated more and more to many other purposes and a majority of the States have let themselves become dependent upon this income for maintaining their various agencies other than their highway departments. Today more than ever before, our national welfare is greatly dependent upon our highway system. Much of the flow of war materials is entirely dependent upon truck transportation. Troop movements are going on over the entire country and the highways must be maintained for this added burden of heavy transport. Just how this is to be done in the face of sharply declining revenue it is difficult to state.

These data here presented were obtained from a study of State Tax Collections, by Type of Tax, by States, which was compiled by the Department of Commerce, Bureau of the Census. It is quite unlikely that the above mentioned percentages would vary to any marked degree for the year 1941 for which complete data are not yet available. The results of this analysis, presenting a total of all State taxes collected, the motor vehicle fuel tax, motor vehicle registration and license fees and the ratio of fuel taxes and license fees combined to all taxes, are shown in Table B.

While some of the State governments are relatively more severely affected, the Federal Government will also find some of its much needed revenue curtailed as a result of this same restricted distribution of gasoline. As a result of the Federal tax on gasoline and

lubricating oil $362,087,000 was turned into the national treasury during 1941 from the country as a whole. Even though it is impossible at this time to say just how much of this revenue was received from States in the affected gasoline rationing area we can easily work out an approximate figure. As mentioned earlier the 19 States and the District of Columbia accounted for approximately 40 per cent of the total returns of State gasoline taxes. Applying this percentage to the Federal taxes from gasoline and oil we can assume that $144,278,000 came from these States. On the present basis of an over the year average cut of 35.8 per cent in gasoline deliveries to retail outlets in the rationed States we have the resultant figure of $51,652,000 that our national givernment will lose in taxes during 1942 as a result of gasoline rationing. But that is not the end of the story.

In excise taxes received from the sale of new cars, motorcycles, trucks, tires and tubes the Government received $149,866,000 during 1941. New tire stocks were frozen in January as were also the sale of passenger cars. Rationing of trucks went into effect March 9 with a complete stoppage of production to take effect in May. This means that a negligible amount of excise taxes will be realized from the tires and tubes, cars and trucks that will be doled out by rationing boards throughout the country for civilian use. (No excise taxes are charged on any items sold to the Federal Government.) While it is purely an assumption on our part, it is felt that the United States Government will lose in the neighborhood of at least $125,000,000 in excise taxes formerly collected from the manufacturers of motor vehicles, tires and tubes. It is assumed that the sale of replacement parts and accessories will continue to bring in a fair amount of excise taxes to the national treasury during the present year as compared with last year when $18,562,000 was collected.

Discontinuance of motor vehicle production and the introduction of gasoline rationing in the eastern seaboard States, both caused by the war and of vital urgency for carrying on the war, will cause a drop in State and Federal tax returns in 1942 as compared with 1941 of $318,232,000. This total breaks down to $141,580,000 from the States in the gasoline rationing areas, $51,652,000 from the national treasury on gasoline taxes and an additional $125,000,000 from that same treasury in the form of excise taxes. In other words, all the new forms of taxes for 1942 will have to absorb or overcome nearly $320,000,000 of vanished tax revenue from these sources alone and no doubt additional losses from other sources not considered here, before the 1942 total tax revenue exceeds that of 1941 by a single dollar.

The irony of the situation is that the identical conditions which have necessitated heavier revenues from taxes, are accountable for a tremendous reduction of tax revenues through the complete conversion of the automotive industry to war production and the limitation of the use of automobiles by the general public.

TABLE B

	Total of all State Taxes	State Gasoline Taxes	State License Fees	Total Motor Vehicle Taxes	Ratio of Motor Vehicle Taxes to Total Taxes
Alabama	$55,134	$15,301	$3,600	$18,901	34.2
Arizona	20,194	4,610	1,163	5,773	28.6
Arkansas	34,111	11,013	3,438	14,451	42.3
California	330,848	51,144	14,654	65,798	19.8
Colorado	39,826	9,252	2,343	11,595	29.1
Connecticut	61,944	10,568	7,140	17,708	28.5
Delaware	13,169	2,205	1,131	3,336	25.3
District of Columbia	.....	.....	.....	.....	....
Florida	60,697	25,511	7,328	32,839	54.1
Georgia	52,935	21,614	2,895	24,509	46.3
Idaho	14,053	5,281	328	5,609	39.9
Illinois	270,148	43,688	24,187	67,875	25.1
Indiana	100,514	24,565	11,798	36,363	36.2
Iowa	72,906	16,771	11,650	28,421	38.9
Kansas	43,352	10,054	4,204	14,258	32.8
Kentucky	53,404	13,458	3,471	16,929	31.6
Louisiana	81,420	18,251	5,401	23,652	29.0
Maine	24,646	6,133	4,090	10,223	41.4
Maryland	56,899	11,232	4,525	15,757	27.6
Massachusetts	158,726	21,134	7,379	28,513	18.0
Michigan	194,199	31,243	22,125	53,368	27.4
Minnesota	83,470	18,646	9,512	28,158	31.4
Mississippi	35,185	12,101	2,567	14,668	41.6
Missouri	92,825	13,904	10,741	24,645	26.5
Montana	14,954	5,030	1,084	6,114	40.8
Nebraska	28,609	11,860	2,834	14,694	51.3
Nevada	4,657	1,510	291	1,801	38.6
New Hampshire	15,844	3,746	2,966	6,712	42.3
New Jersey	153,838	23,271	20,119	43,390	28.2
New Mexico	17,578	4,975	2,004	6,979	39.7
New York	587,735	70,931	50,950	121,881	20.7
North Carolina	86,240	25,946	8,655	34,601	40.1
North Dakota	14,062	2,292	1,622	3,914	27.8
Ohio	265,327	51,428	28,318	79,746	30.0
Oklahoma	61,879	14,495	6,164	20,659	33.3
Oregon	31,825	12,381	3,603	15,984	50.2
Pennsylvania	337,326	57,008	37,464	94,472	28.0
Rhode Island	20,571	3,847	3,457	7,304	35.5
South Carolina	34,637	12,838	1,915	14,753	42.5
South Dakota	17,401	5,412	937	6,349	36.4
Tennessee	51,826	19,664	4,903	24,567	47.4
Texas	144,696	45,948	8,689	54,637	37.8
Utah	19,733	3,874	1,218	5,092	25.8
Vermont	11,641	2,703	2,599	5,302	45.5
Virginia	56,808	18,236	7,071	25,307	44.5
Washington	69,359	16,234	5,909	22,143	31.9
West Virginia	56,236	10,690	5,304	15,994	28.4
Wisconsin	97,266	20,670	13,196	33,866	34.8
Wyoming	8,160	2,756	604	3,360	41.1
Total	$4,164,813	$845,424	$387,946	$1,233,170	29.6% avg.

Buick's Warplane Engine Plant

By Joseph Geschelin

WITHIN THE space of less than 10 months from the time the go-ahead signal was given, Buick-built aircraft engines began rolling off the assembly lines of the new engine plant in January, 1942. It was not a simple task, for besides the conversion of two large automobile factory units, this job involved the construction and outfitting of an entirely new factory.

Structurally, and from the standpoint of machinery and plant layout, the new Buick engine plant is one of the finest in this country. Under a single roof it covers many acres of productive floor space including the test cell division. The layout of the floor plan and the disposition of departments and machinery all have been conceived specifically to meet the demands of aircraft engine production following the pattern of automotive straight line mass manufacturing procedures. On the other hand, the layout has been so developed as to meet the special needs of the situation.

Although most of the engine components are made in the new plant, some of the major parts such as crankshafts and crankshaft assemblies, as well as connecting rods, are made in other Buick plants and shipped to the new plant for installation on the final assembly lines. The new plant has been subdivided into a number of specific manufacturing departments, including the following—crankcase sections, blower sections, carburetor mounting, pistons, nose section, cylinder barrels, etc. In addition, there is a large gear cutting department, a gear grinding department, miscellaneous grinding department, a large heat treating department, plating department, inspection, and assembly department.

Transportation of raw materials to each of these departments, as well as the movement of finished parts to the bond room and to assembly stations is handled by a sizable battery of industrial factory trucks of various makes and types. Among these are the familiar units made by the Automatic Transportation Co., and by Clark.

Now a word as to the factory structure. Of steel, brick, Gunite and continuous steel sash construction, the main factory building is one story high and has 10 monitors extending the entire length of the building. The main manufacturing building is equipped with a ventilating system designed to keep the inside temperature within 10 deg. of that outside. There are

(Left) In keeping with modern practice, many of the major parts are inspected for surface perfection in special Magnaflux machines. This one, in the gear department, is inspecting a ring gear.

(Below) Here is one of a large battery of Fay automatic lathes for rough and finish turning of cylinder barrel fins.

its modern machine tool equipment and the techniques adopted for large scale production

575 motor driven fans in the ventilating system, including 210 intake and 210 exhaust ventilators.

The factory building is heated in winter by overhead unit heaters of the projection type and is divided into four zones with zone thermostats that regulate artificial heat in accordance with the amount of sunshine in each zone. The manufacturing building is artificially lighted by fluorescent lights of which 9500 fixtures were required. The light intensity is from 40 to 45 foot candles, which approximates daylight.

Adjoining the manufacturing building is the engine test building which houses the test cells. Engines are transported from the assembly department by means of three bridge cranes with underslung, detachable cabs that can leave the crane and operate independently on a monorail. These convey the finished engines right into the test cells and back to the tear-down and re-assembly department. The walls and doors of the test cells are of concrete, painted with Pyraseal which affords a dense non-absorbent surface that is easily cleaned. Cells are fully soundproofed and the stacks are of acoustical material and construction.

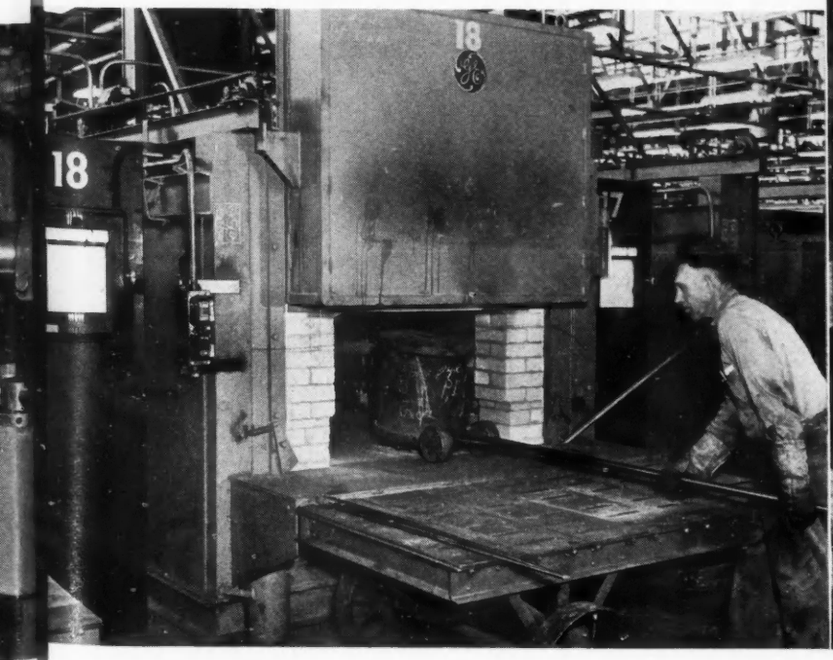
This is the Seventy-first in the series of monthly production features

Details Production Equipment

Designed new from the ground up, it is small wonder that the Buick plant is replete with machinery of the latest types known to the art. Some idea of the scope of the machining layout may be gained by noting a few of the makes of machines represented here—large

(Right) Here is the operator's station at one of the Detroit Rex degreasers in the gear department.

(Below) One of the General Electric carburizing furnaces for degreasers in the gear department.



batteries of Bullard Mult-Au-Matics and Bullard V-T-L's; Natco Holesteel vertical multiple-spindle drill presses and a battery of special 5- and 6-way horizontal machines; Sundstrand stub lathes and milling machines; Norton cylindrical grinders and angular wheel head grinders; Cincinnati milling machines; Kearney & Trecker milling machines; Ex-Cell-O precision grinders and precision boring machines; Heald Bore-Matics, internal grinders, rotary surface grinders; Fay automatics; Landis hydraulic radial grinders; Van Norman milling machines and contour millers; Fellows gear shapers, gear lappers, and a new gear grinder; P & W gear grinders; Fitchburg spline grinders; Barber-Colman gear hobbers; a large Gleason department; Gisholt Simplimatic lathes; Foster Fastermatics; and many others.

Ex-Cell-O has supplied a number of special drilling and precision boring machines for many of the operations in the new plant. Among these are—a special two-way drilling machine with an automatically indexing seven-station table; and a special two-way machine for drilling, core-drilling, and rough boring pin holes in the pistons. The first of these machines is employed for the drilling of intake and exhaust valve guide holes in the crankcase.

Natco has supplied a large number of horizontal and Holesteel vertical multiple-spindle drilling machines for operations in the new plant. As an example of the way-type equipment, we note the details of one of the five-way horizontal combination drilling and tapping machines on the machine line for the crankcase blower section. A feature of this machine is a special rotating table, 30 in. in diameter, providing 14 stations automatically indexed and interlocked with unit controls.

Quality and Precision

Buick practice in building this engine is an outstanding example of exacting quality control at every stage of the process and incorporates some unusual requirements as to dimensional tolerances. Just a few examples of these tolerances should suffice to provide a picture of the metal cutting problem. Consider the cylinder barrel. On Bullard Mult-Au-Matics a rapid and automatic cycle on a multi-station machine, the finish-boring is held to 5.745 in. diameter plus 0.005 minus 0.000 in. Finish turning, on the same machine, is held to 7.250 in. plus 0.000 minus 0.010 in.

On the cam rings, the grinding operations are held as follows—the tooth face, ground on a Heald rotary surface grinder, is held to 1.766 in. plus 0.003 minus 0.000 in. The center bore, finish-ground on a Heald internal grinder, is held to 7.438 in. plus or minus 0.0005 in. Finish-grinding of the cam contours over the lobes, on Landis radial cam grinders, is held to 8.630 plus or minus 0.002 in.

Some of the drilling and reaming operations are very fussy indeed due to the nicety demanded of airplane engine fastenings. Consider some examples of this on the crankcase rear section. Dowel holes, reamed in single-spindle Leland-Gifford sensitive drills, are held to 0.3125 in. plus or minus 0.0005 in. Holes drilled and reamed on American radial drills are held, in reaming, to 0.781 in. plus 0.001 minus 0.0005 in. Even milling operations on these parts are held to extremely close tolerances. One pad location, milled on a Van Norman vertical milling machine, is held to 1.750 in. plus and minus 0.005 in. On a number of boring operations, on Heald Bore-Matics, we find extremely strict requirements on finish boring.

On pistons, grinding on a Norton Type C cylindrical grinder, the top ring land is held 5.464 in. plus or minus 0.001 in.; while the body O.D. is held 5.477 in. plus or minus 0.001 in. Precision boring of the wrist pin hole on an Ex-Cell-O single-end machine, is held to 1.3729 in. plus 0.00035 minus 0.00025 in.

Gear Practice

The Buick-built engine, incorporating 17 different gears, takes a total of 30 gears per assembly. Generally speaking, the gear department is set up to make internal and external spur gears, bevel gear rings and pinions, cam ring internal spur gears, and splines—internal and external. Many of the internal and external gears are cut on Fellows gear shapers of various types and sizes. Other gears and splines are hobbed in Barber-Colman hobbing machines. At the present time most gears are finished by grinding, after heat treatment, a large battery of familiar Pratt & Whitney precision gear grinders being available for this purpose. Of the 17 different parts, 13 are being ground on the P. & W. machines. Certain other gears and splines are finished on Gear Grinding Machine Co. grinders and on Fitchburg spline grinders.

Drawing upon their experience with high grade passenger car transmissions, Buick experts are experimenting with the SHAVING process to supplement

61-A Fellows gear shaper cutting 76 spline teeth in the reduction driving gear.

gear grinding and to expedite the finishing of certain types of gears. This work is under way now, but not available for publication at this writing.

Bevel gear rings and pinions are cut on Gleason generators of familiar types, run-in on Gleason machines. To prevent distortion during the quenching operation, certain gears are quenched in the Gleason quenching machines, using special dies for the purpose.

Metallurgical Practice

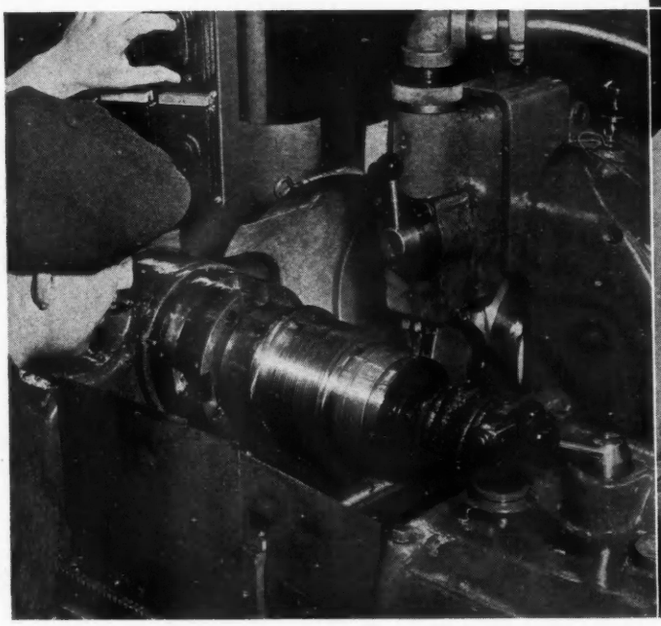
All heat treating procedures, metallurgical inspection, plating and metal cleaning processes are under the control of the chief metallurgist, although the actual inspection operations are handled by the quality control department. Since the eventual performance of every component of the airplane engine depends not only upon the care

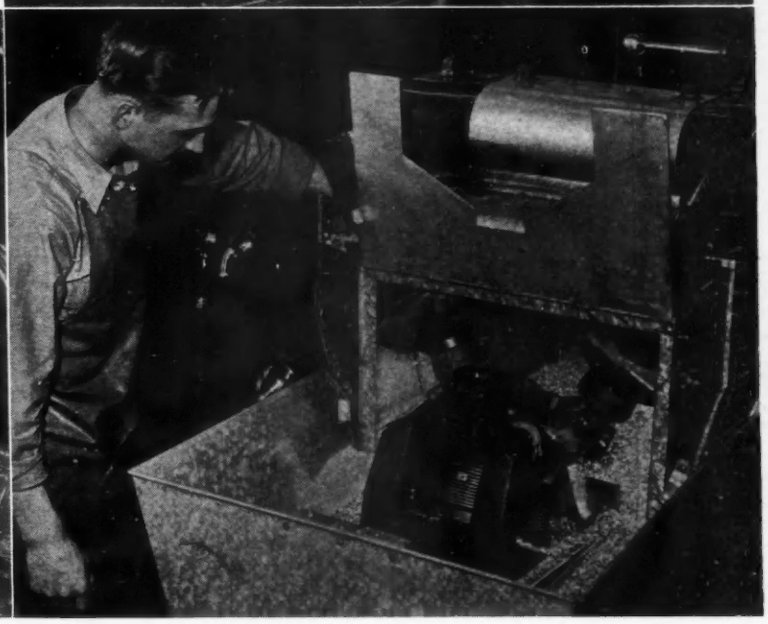
(Top, right) This Natco 5-way horizontal drilling machine is an example of the mass-production tooling developed for the Buick engine line. The machine shown here is on the blower section line.

(Right) Norton Type G angular wheel slide grinder, grinding face of cylinder barrel flange to close tolerances on dimensions.

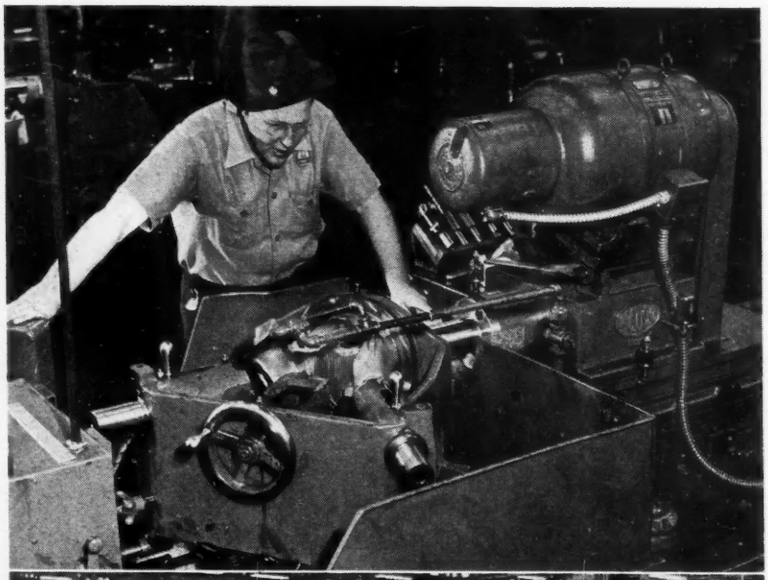
(Bottom, right) One of a battery of 2K Kearney & Trecker Duplex milling machines for milling rocker box cover seats in cylinder heads.

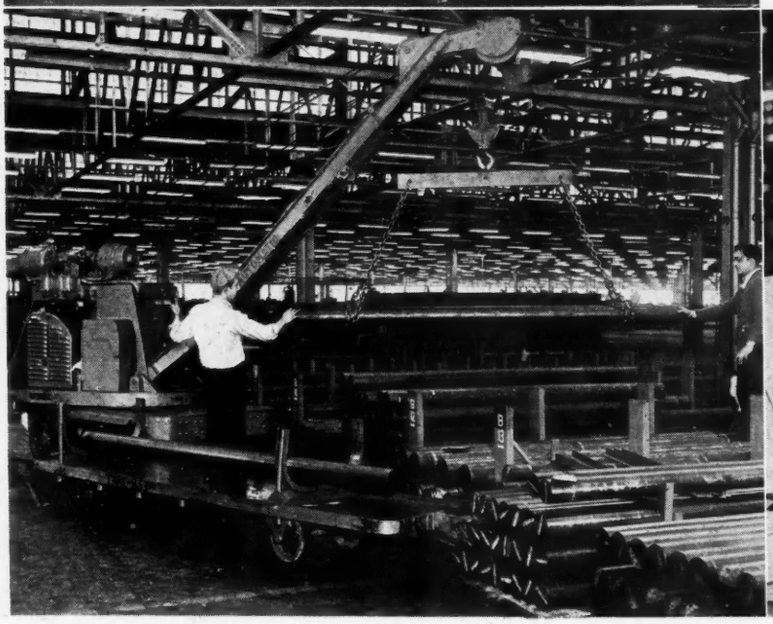
(Below) 12 by 45 J & L automatic precision thread grinder, finish grinding the cylinder barrel thread.





Special horizontal Natco boring machine with two-position indexing fixture for boring operations on cylinder heads. It is used principally for finishing valve guide holes and valve seats.





exercised in its processing but upon the steel mill practice as well, there is an elaborate control system in effect which provides a key to the steel mill heat in which each component originated.

Starting with the rough forgings, each gear blank, cylinder barrel, shaft, etc., is given a code number that identifies the steel mill heat, chemistry, and test data. Data on each batch of forgings are tabulated on a card record for future reference in the event of failure or troubles in production. The basic code number is made a part of each machined piece so that it is possible to trace back directly to steel mill practice, if need be.

The heat treating department is provided with the latest types of electrically fired equipment — including G. E. furnaces, Westinghouse furnaces, Leeds & Northrup Homocarb hardening furnaces, Homo drawing furnaces, and other types. Most of the equipment is of batch type. Most of the carburizing

(Left) Among the many filing, polishing, and burring benches is this one in the crankcase department. It is provided with Thor electric and pneumatic portable tools for filing and burring.

(Bottom, left) One of the three Automatic Transportation Industrial trucks in this plant. Two are of 4000-lb capacity, telescopic, tilting, tiering fork trucks. The single crane unit shown here is of 3000-lb capacity for heavy lifting and spotting, with push button remote control for operation of boom and hoist units.

(Below) V-26 Do-All sawing machine is used for cutting off the work-lug on cylinder head castings after initial machining.

is done with a gas atmosphere, as in the case of the Homocarb units, although there is some box carburizing equipment. Hardening is done with a controlled gas atmosphere, each hardening unit being provided with a suitable gas generator for supplying a non-scaling atmosphere.

At the present time, Buick has one Ajax salt-bath furnace which is used for hardening crankshaft flyweights made of high-speed-steel. The same equipment will be employed for the hardening of molybdenum tool steel, just as soon as the high-speed-steel tool practice is swung over to the Mo-Max type of tool materials. Among the other activities of the metallurgical department is the operation of plating facilities. At the moment they are plating cadmium, copper, lead, and tin coatings. The copper is used exclusively for masking purposes in heat treatment.

Tool Practice

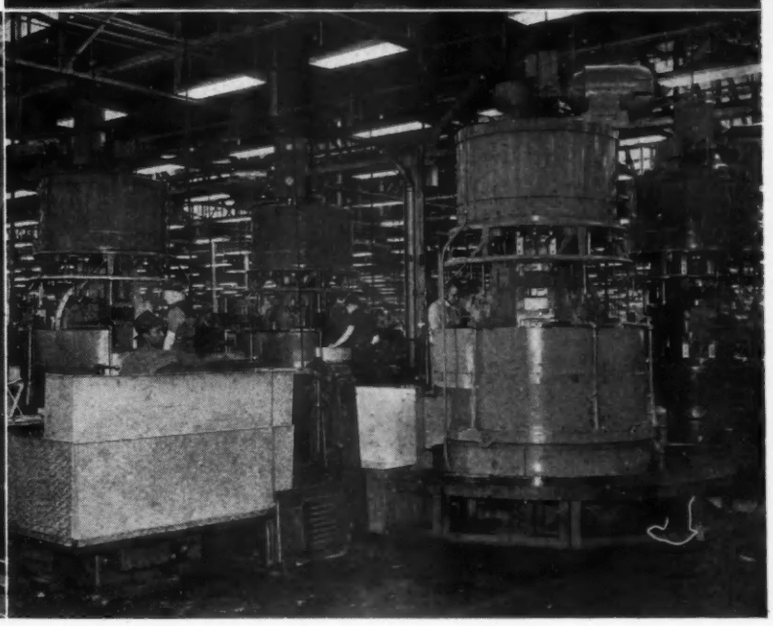
In keeping with current trends, Buick has undertaken a comprehensive

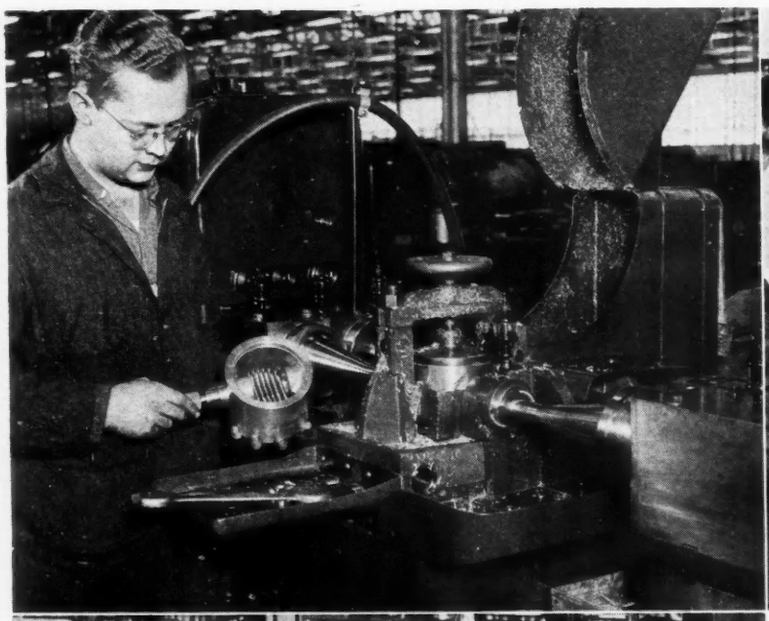
Single-end Heald Bore-Matic Type 46-B is used for rough boring and facing four holes in the crankcase rear section.

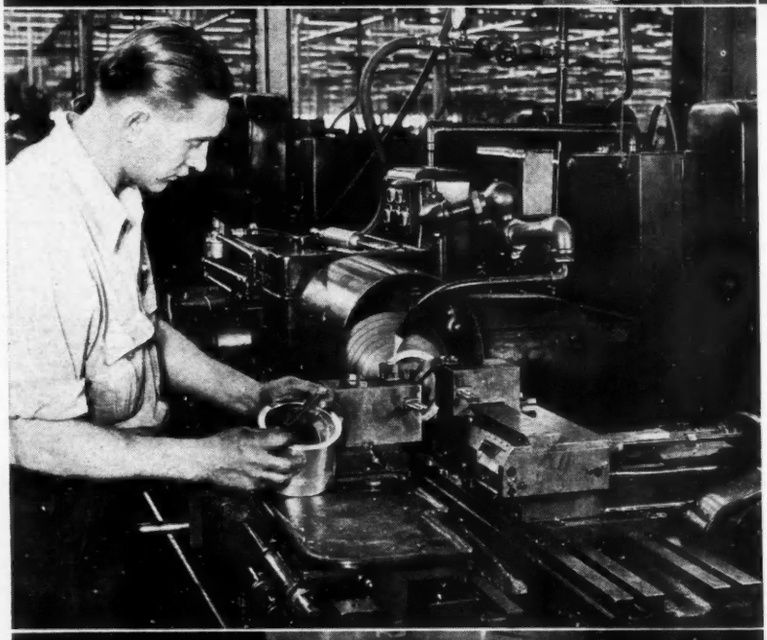
(Right) Latest unit of the familiar Bullard-Dunn descaling process is found in the heat treating department for the chemical cleaning of gears before heat treatment.

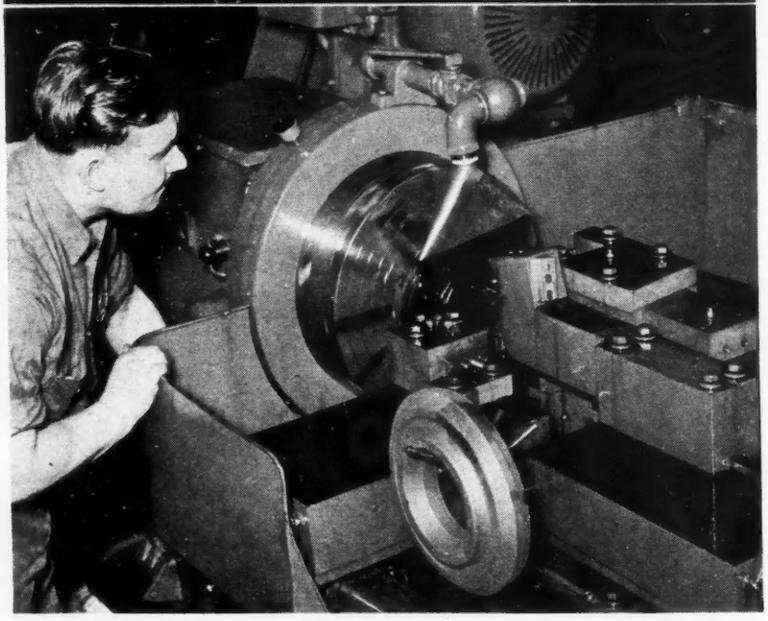
(Bottom, right) A forest of the towering Bullard Mult-Au-Matics handles the initial machining operations on cylinder heads and cylinder barrels.

(Below) Cincinnati Model 2-MH milling machine milling valve clearance in the piston head.









(Above) Close-up of the Sheffield Multichek Electrigage which is used for the final inspection of pistons.

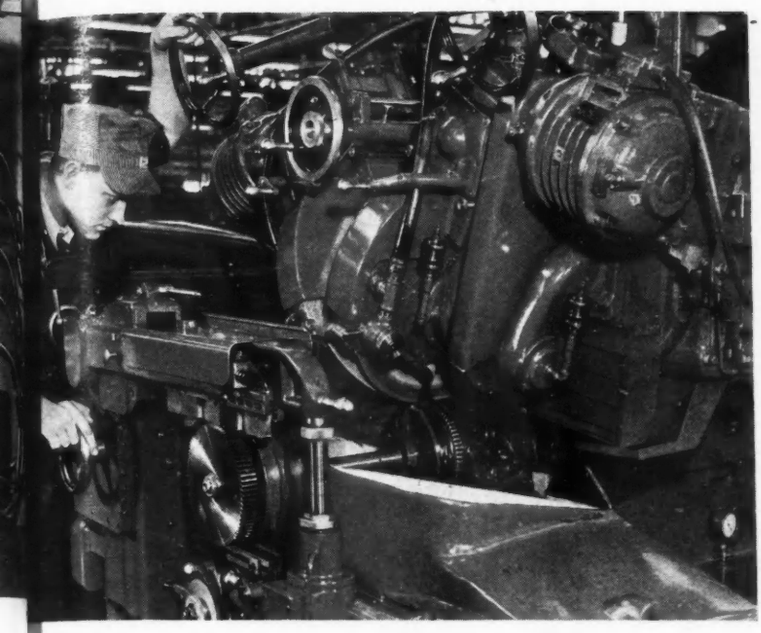
(Above, left) No. 54 Ex-Cell-O two-way precision boring machine core-drilling, boring, and counterboring wrist pin holes.

(Left) Sundstrand Type B automatic Stub lathe rough turning pistons with front carriage tools, rough facing top with rear tool slide.

(Bottom) Gisholt Simplimatic lathe on the first operation on the reduction drive gear—rough boring spline diameter, rough facing end of hub, rough turning hub diameter.

research program to increase the effectiveness of metal cutting by the application of special cutting tool materials. At the present writing Buick is using experimental cemented-carbide tools supplied by leading producers such as Carboloy, Ramet, McKenna, Firth-Sterling; also Haynes-Stellite tools; and the diamond. Fortified by a vast store of experience in passenger car manufacturing, the production department has applied cemented-carbides not only on the non-ferrous castings but on steel forgings as well. Thus the steel cutting grades are being used on Gisholt Simplimatics, on Foster Fastermatics, on Bullards, on Ex-Cell-O and Heald boring machines—for the machining of gear blanks, cylinder barrels, and other parts.

The industrial diamond, which incidentally is making a great place for itself in this war, has been applied in precision boring, and for abrasive wheel dressing. For example, the diamond is



View of one of a battery of P & W precision gear grinders in the gear department. The operation shown here is the finish grinding of 80 teeth of the cam ring.

being used for finish-boring wrist pin holes on an Ex-Cell-O precision boring machine. Diamond dressing tools are found on a variety of grinding equipment including the following — Heald internal grinders, Bryant internal grinders, Norton angular wheel slide grinders, Heald rotary surface grinders, Landis radial cam grinder and P. & W. precision gear grinders.

Special Process Details

Among the many special techniques in this plant are the many metal washing, cleaning, and vapor degreasing operations in various parts of the plant. G. S. Blakeslee & Co., makers of the Niagara equipment, have something over 40 individual items here, including six different types and sizes. In this category are single-tank and double cabinet kerosene hand spray washers for cleaning parts between machining operations; six-station cabinet kerosene hand spray washers of the same type. Among the continuous production machines is a three-tank horizontal conveyor kerosene washer for handling large parts such as cylinder barrels which are placed directly onto the wooden flight conveyor. Smaller parts are handled in baskets in the same machine. In addition, there is a Niagara two-stage kerosene washer with horizontal conveyor similar to the three-tank unit.

An unusually large piece of equipment is the Niagara kerosene spray and air blow-off double booth for cleaning complete engines after each test run. It is located in the assembly department. Each engine is washed seven times, air-blown and examined between each test run. The heat treatment department is provided with a Niagara washer for removing quenching oil. This is a single tank pump type alkali washer, provided with a revolving table with a carriage moving in and out of the washer so that the parts on the carriage can be brought under the spray.

Buick also has a large battery of Detroit Rex "Detrex" degreasers for the cleaning of major parts of the engine. Several examples typical of the use of this equipment may be noted. For instance, in the piston machining department, the Detrex degreaser—VS 800 size—is used for washing the machined piston. Here the work is handled in baskets, lifted by a monorail air hoist. The piston is again cleaned before weighing and final inspection.

On the large non-ferrous castings such as the crankcase rear and the blower section, the rear section is cleaned in a Detrex degreaser, using the Perm-A-Clor solution. The blower section is cleaned in a Detrex machine after the water test and again immediately preceding final inspection. On gears such as the cam rings, front and rear, the parts are cleaned in a Detrex machine before heat treatment, after quenching, and again before final inspection. On the reduction drive driving gear, the work is cleaned in a Detrex degreaser after heat treatment, after quenching, and, finally, preceding Magnaflux inspection. In all there are upwards of 30 of the Detrex units in various sections of the plant, including vapor-slush type, vapor units, and two-dip type.

Cylinder heads are coated with an aluminum spray by means of a metallizing gun after machining and assembly with the barrel. In preparation for metallizing, the heads are sand-blasted in a large conveyor type Pangborn machine. Aluminum is sprayed on in a special six-station machine developed by the U. S. Galvanizing and Plating Equipment Co., fitted with metal spray guns made by the Metallizing Engineering Co.

Needless to say, the machine shop is replete with facilities for the burring, filing, grinding, and polishing of the engine components consistent with the requirements of over-all finish of airplane engine parts. Such equipment usually is arranged on separate benches in the vicinity of the department in which the parts are machined. As one example, we have a line of Kellerflex bench type portable tools in the cylinder head department. Elsewhere there are large numbers of Independent Pneumatic "Thor" air-driven tools and the new Thor high-cycle electric tools for various polishing operations and for the fitting of fastenings.

Test Cell Data

The plant is provided with outstanding test facilities, includes the following equipment:

1. A self-contained wind tunnel propeller test house for the simulated flight testing of engines.
2. One engine dynamometer stand.
3. Three Midwest dynamometer rooms.
4. Standard test cells fitted with generators.

The test department has been laid out skillfully to facilitate an economic operation. The provision of electric generating equipment as a means of power absorption in the standard test cells now in operation, makes

(*Turn to page* 82, *please*)

"Green" parts are placed in a sintering furnace where the atmosphere is controlled to exclude oxygen. The sintering temperature is 25 per cent below the melting point of the metal.

Powder

Illustrations by courtesy of Moraine Products Division, General Motors Corp., except as noted.

ALTHOUGH the science of powder metallurgy has a literature dating back to 1829, its commercial applications have been quite limited in scope during the past 20 years or so. In fact, the scope of its engineering uses has begun to be realized only during the past few years what with the pioneering efforts of some of the leading producers in the field. Since there is a complete literature on the subject, the purpose of this discussion is to draw the attention of engineers and production men to the present status of the art, to touch upon its potentialities, and to emphasize the importance of powder metallurgy in the future.

The entire picture has taken on new significance in the past few years with the realization that the method can be extended to the fabrication of a great variety of special parts, some of them intricate parts, for automotive use. Needless to say, in each instance the new technique has justified itself by offering lower costs or special properties not obtainable by any other means. More recently, some of the leading producers have been experimenting with powder metallurgy for the production of items going into the weapons of war, aiming at the conservation of critical materials or at speeding up the process of production, or at a reduction in cost or combinations of these.

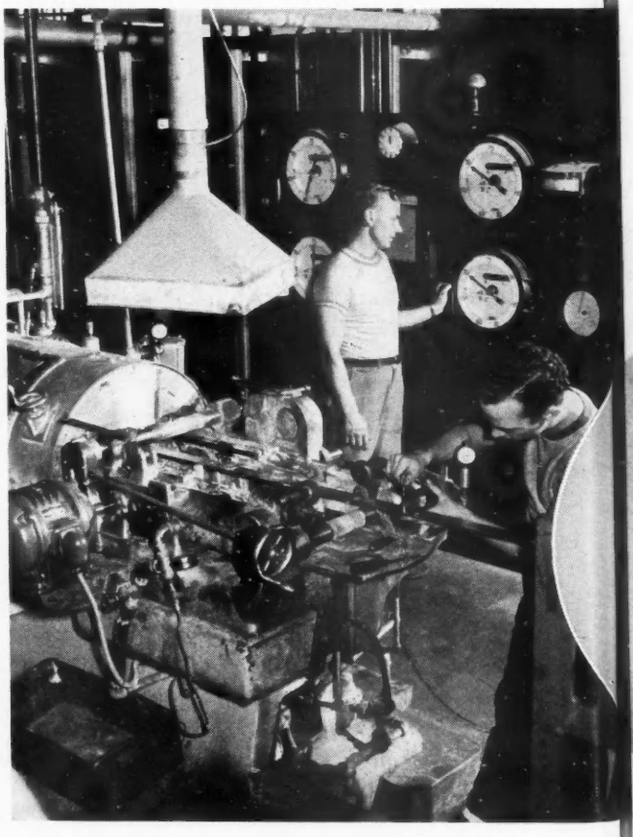
It is important to emphasize under conditions of a war economy, that powder technique offers the following unique advantages:

1. It makes possible the substitution of iron for scarce materials.

2. It makes possible a major saving in strategic or critical materials by eliminating most of the scrap loss.

3. In the fabrication of intricately formed parts, it eliminates machining and, thereby, frees valuable machine time.

Due to the efforts of leaders in this field, powder metallurgy no longer is limited to parts of small size. For example, the Amplex Div., Chrysler Corp., has furnished bearings ranging from 12 in. to 18 in. in outside diameter; and recently quoted on a bearing 91 in. in diameter. Another of the recent contributions of this organization is the development of "solid" metal parts of normal density which



Another method of making bearing shells is to bond a bronze matrix by sintering to a steel backing and then pass the strips through a bath of molten babbitt, which is forced into the bearing matrix by exhausting the air. Following the application of the babbitt, these strips are cut to size and formed into half-circle Durex bearings to be used later in pairs. In the illustration at right the strip is shown entering the machine that forces the babbitt into the matrix.

Metallurgy—

Its rapid expansion and its importance in the war economy

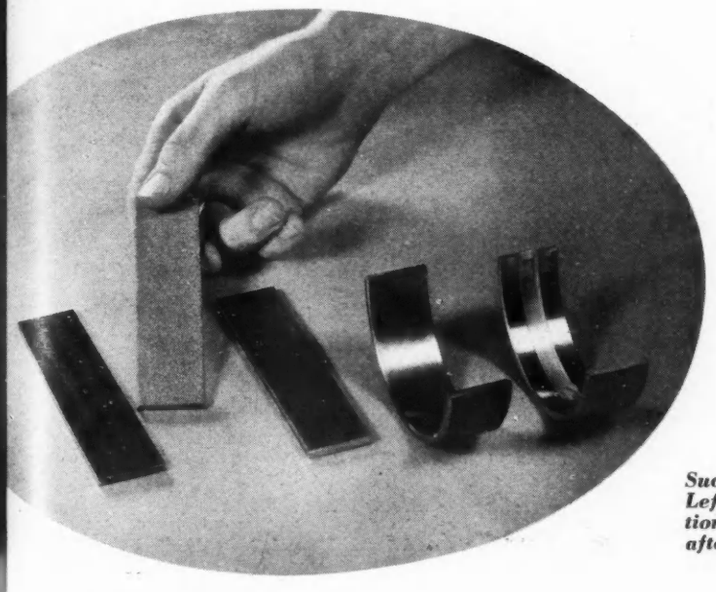
By Joseph Geschelin

Iron powder can be used for an almost unlimited range of metal parts. This photograph was made with a high speed camera at 1/30,000 sec.

compare with forgings and stampings in physical strength. One recent test indicated a tensile strength of 123,000 psi.

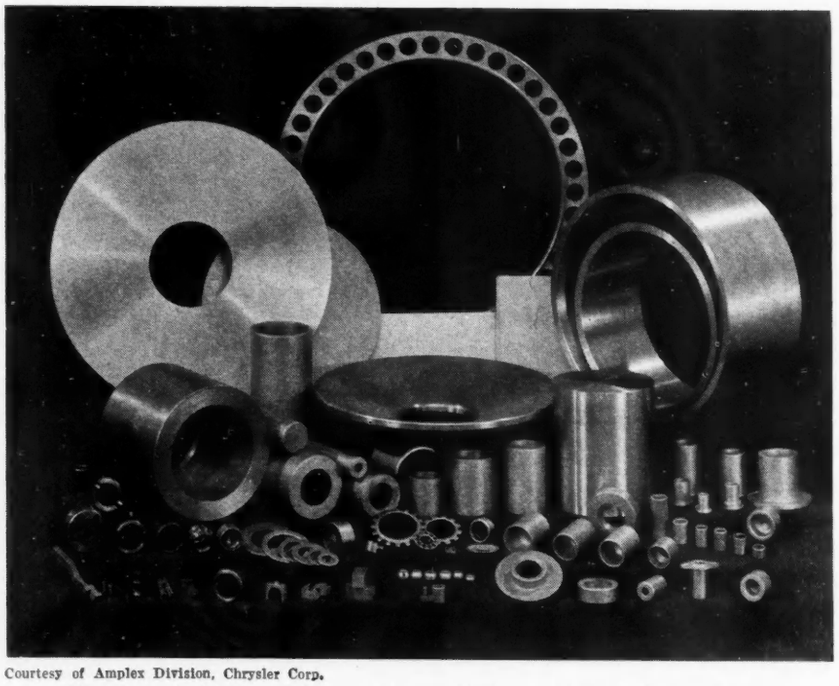
When it comes to iron powder products, one can recall that not so long ago it was thought that only Swedish iron could be acceptable. Today, American smelters are producing a superior iron powder which assures freedom from any foreign sources of supply during the war and after the war.

The point we wish to emphasize is that designers must recognize powder metallurgy as a new technique of great and unplumbed potentiality. Current literature will acquaint engineers with the character of applications that have been developed during the past year or so. And this, in turn, may provide the starting point for new ideas. We may add, too, that the specialists in this field will be glad to study these new ideas and are in a position to advise as to their practicability. Above all, engineers should acquire a practical background of what can be done as well as what the limitations are so as to facilitate the most practical solution for each problem.



Successive stages in the manufacture of Durex-100 engine bearings. Left to right—strip steel, copper-nickel matrix, strip after application of babbitt, bearing formed in half-circle, and finished bearing after hole is drilled, groove milled and the surface diamond bored.

Powder metallurgy is distinguished from all other metallurgical processes in this unique fact—that in the entire cycle from the formulation of the pure powders to the forming and sintering of the finished parts, the basic metals are never in the molten state. Although this fundamental principle may not be generally appreciated, it is responsible for much of the unique character of everything that is made by



Courtesy of Amplex Division, Chrysler Corp.

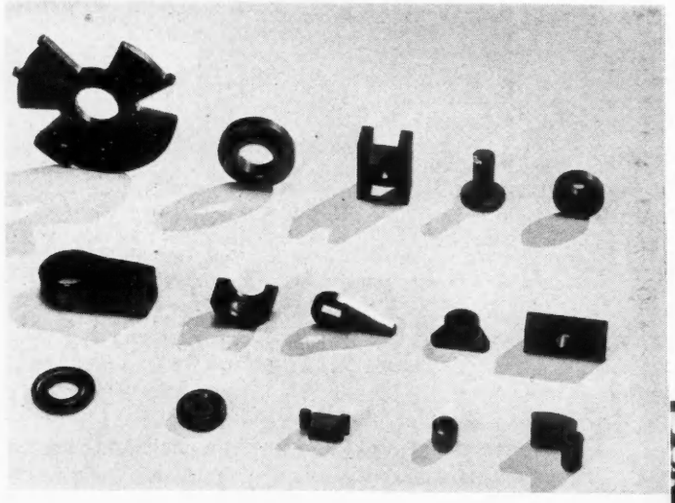
A group of Amplex Oilite and Super-Oilite parts, including bearing retainers, thrust bearing retainers, Gyrotor gear sets, levers, cams and others.

point metals such as tungsten, molybdenum, tantalum, and columbium whose melting points are too high for conventional melting and casting techniques.

2. Use of two or more metal powders to produce "alloys" (actually mixtures) retaining the individual characteristics of each constituent. Examples of this are found in the making of electrical contacts and welding electrodes; also in the making of extremely

Producers of Parts by Powder Metallurgy

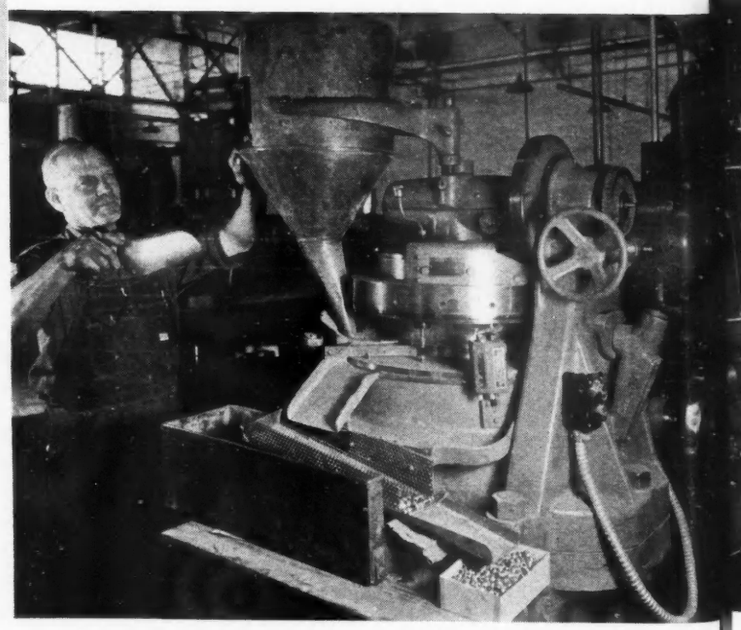
Amplex Div., Chrysler Corp., Detroit, Mich.
Boundbrook Oil-Less Bearing Co., Bound Brook, New Jersey
Johnson Bronze Co., New Castle, Pa.
Keystone Carbon Co., St. Marys, Pa.
Moraine Products Div., General Motors Corp.
National Molded Products Co., St. Marys, Pa.
Neveroil Bearing Co., Wakefield, Mass.
Powder Metallurgy, Inc., New York, New York
Powder Metals and Alloys, Barberton, Ohio



(Left) An assortment of Moraine Durex iron parts including cams, thrust washers, bearing races, sliding blocks and others.

(Bottom Right) After the briquetting and sintering operations, these porous bearings have been cold sized in this machine preliminary to inspection. Then they are immersed in a bath of oil.

(Below) Millions of parts are compressed in automatic machines from metallic powder. This rotary type 15-ton machine can accommodate as many as 16 sets of punches and dies, and its production rate goes as high as 150 parts per min.



the process. Among such inherent advantages are the followings:

1. Ability to combine metals not miscible in the liquid or solid state.

2. Alloying of metals having widely different melting points, through pressing and sintering at relatively low temperatures.

3. Possibility of producing metals or alloys of higher purity than is possible by fusion methods.

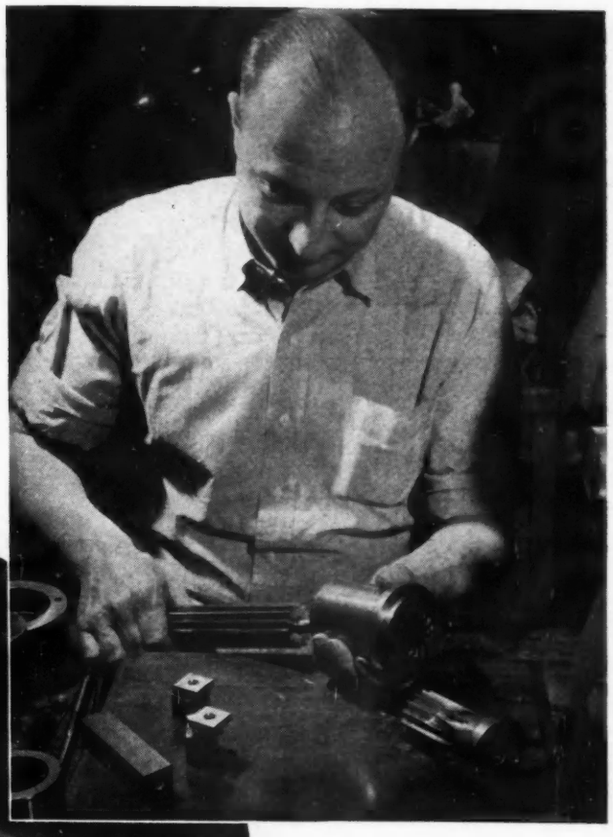
The generalized field of applications of powder metallurgy may be visualized by reference to a brochure, entitled "The Field of Powder Metallurgy," published by Metals Disintegrating Co. Briefly, the outline is as follows:

1. Use of powders in fabrication of high melting

high density metals used for balance weights for crankshafts, vibration dampers, etc.

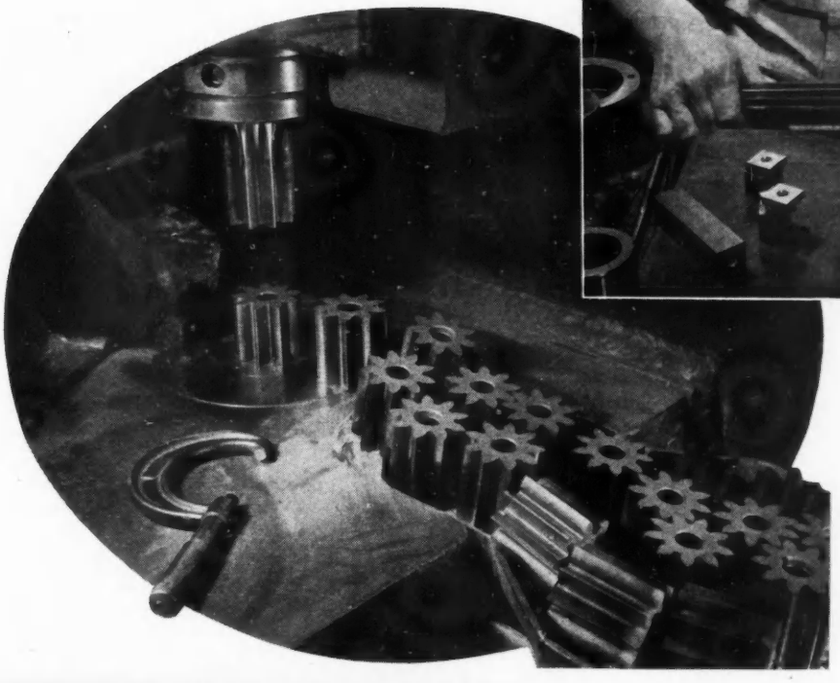
3. Use of powders for combinations of metals and non-metals as in the case of porous metal bearings, diamond impregnated grinding wheels and disks, current-collector brushes, and in the cemented-carbide cutting tools.

4. Use of powders for the development of unusual structures. Examples of this are—self-lubricating bearings, multiple layer structures such as the Durex thin babbitt engine bearings in which a matrix of copper-nickel is bonded to a steel back, the Durex porous metal filter element, etc.



(Above) For making oil pump gears, the tools have a close fit, yet permit air to be forced out at high pressures. Briquetting tools consist of a die barrel; a lower punch that forms the bottom of the die barrel cavity and serves as an ejecting punch after the part is pressed; a core rod extending through the lower punch and die barrel to form the hole; and an upper punch for the top of the die barrel cavity.

(Oval) These gears have been compressed to one-third of their original volume.



Powder Suppliers

Metals Disintegrating Co., Elizabeth, New Jersey
U. S. Metals Refining Co., Cartaret, New Jersey
Metals Refining Co., Hammond, Indiana
General Metals Powder Co., Akron, Ohio

5. Use of powders to reduce costs by replacing orthodox operations such as machining, casting, etc.

6. Use of powders to form protective coatings—cementation, and metal powder in metallizing spray guns.

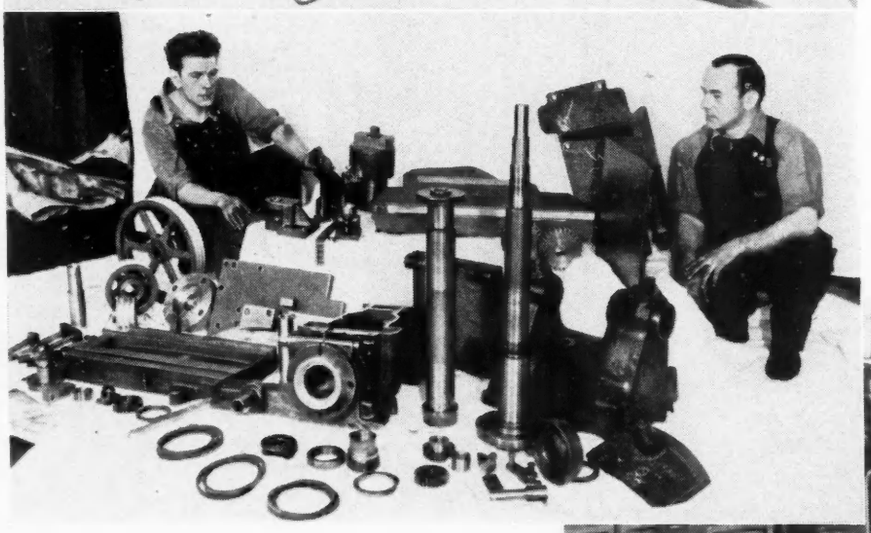
Naturally there are basic limitations such as are expected in any technical process. For one thing, powder metallurgy is essentially a mass production technique because of the relatively high first cost

(*Turn to page* 78, *please*)

Once Gear Finishers for Civilian Jobs,

Now Milling Machines for War Production

How Chrysler Rebuilt 44



AN EXCELLENT illustration of how old machine-tool equipment can be converted to new uses for war production is furnished by the Chrysler organization. The job to be performed was to finish a peculiarly shaped interior surface on a part going into one of the pieces of military equipment turned out by the firm. The surface to be finished serves as a raceway for balls, and, therefore, has to be finished to a high degree of precision. Ordinarily the job would be performed on a milling machine, but there is a big demand for milling machines for war work, and as 44 machines were required to complete the job in the available time, it probably would have been difficult to get them. Chrysler did not have milling

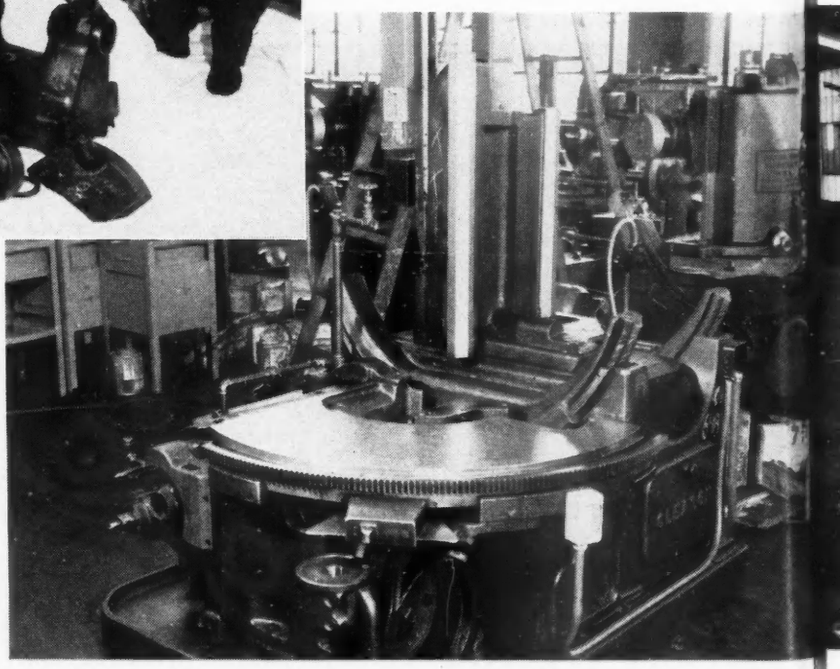


Fig. 1 — Parts removed from one Gleason gear finisher to make the conversion.

Fig. 2—Parts specially made to convert one Gleason gear finished for a milling operation.

Fig. 3—The gear finisher stripped of its superfluous parts.

Machines Assigned to Storage

machines available, but in one of the Chrysler rear-axle plants there were 44 Gleason gear finishers which had been used to finish the spiral bevel pinions of the rear axle drive gears. There is really very little similarity between finishing the teeth on a spiral bevel pinion and finishing a raceway for a ball bearing, but the Chrysler production staff found means to adapt these old machines—some of them 28 years old—to the new job by extensive rebuilding.

As pointed out, what was required to finish the new part was a milling machine, and about the only resemblance of the Gleason gear finisher to a milling machine was that it also had a spindle for rotating a tool. However, these spindles revolved around a fixed horizontal axis, while in the new operation the spindle had to make an angle of 20 deg. with the horizontal, and in addition it had to swing in an arc to follow the curved surface of the raceway.

An idea of the degree of rebuilding required to fit the machines for the new job can be obtained from Figs. 1 and 2, of which the first shows parts that were removed from the Gleason gear finisher because they were not needed or could not be used in making the war part; while Fig. 2 shows new parts that were specially designed and produced to effect the conversion. All of the parts shown in Fig. 2 were made for each of the 44 machines converted. The number, of course, is not large enough to justify special production methods, and all of the parts had to be made by ordinary machine-shop methods. The job required nearly a thousand hours of machine-shop time per machine, in addition to forge and foundry work, assembling and other operations.

The Gleason gear finishers were stripped to the base, as shown in Fig. 3, but the spindles with their bearings and driving mechanism were kept in place. The mounting of the spindle was changed, however, so it makes an angle of 20 deg. with the horizontal, and a curved cradle or track was provided which enables the operator to swing the spindle with its driving mechanism through an arc of 180 deg. so the tool at its end can follow the curve of the raceway. While it is thus swung in space, the tool must cut with a high degree of accuracy.

The machines weighed several tons. Massive supports were cast, machined and fitted to the bases. Numerous bearings, gears, sprockets, clutches, supports, etc., had to be first machined and then assembled to the machine tool. To make the conversion, Chrysler practically had to provide a machine-tool factory within its plant, and it is stated that the amount of work involved in the conversion is greater than that turned out by many small machine tool firms in peace times in the course of a year.

All this conversion work was carried through to obtain equipment for one operation on one part of the finished product. There are 31 operations on the part concerned—not all as difficult and complicated as this one, it is true, but each requiring machine tools, dies, jigs, and fixtures—and the complete machine has several thousand parts. The example serves to give an idea of the immense amount of work that was required to convert automobile plants to war production.

Fig. 4 shows the machine tool as converted. It is now a milling machine suited to the operation in hand. Some initial "bugs," we are informed, were quickly eliminated, and the machine now is performing quite satisfactorily.

Fig. 4—The "converted" machine tool.

PRODUCTION LINES

On Honing

A comprehensive treatise on the fundamental principles used in the honing process has been issued by the Micromatic Hone Corp. It touches on abrading and abrasives, on pressure and motion, direction of motion, speed of operation, and the details of honing equipment. L. S. Martz, the author of this treatise has done much to take the mystery out of the honing technique and in so doing, has provided production men with a sound scientific background. Ask us for a copy of this valuable booklet.

Lubriplate Saves

A complete line of Lubriplate fluid type and grease type lubricants offered for the protection of machine tools, heavy machinery, and heavy drives is said to be given excellent service in many plants doing war production work. According to the manufacturer of this product, Lubriplate possesses a number of unique advantages among which are the following:

1. It is said to arrest progressive wear by maintaining a minute lubricating film between the wearing surfaces.
2. Reduces wear and frictional power loss.
3. It is said to retard pitting and corrosion.
4. The film has long-lasting properties and, consequently, is economical from the standpoint of initial cost.

Fiske Bros. Refining Co., issues bulletins on Lubriplate, showing current applications and experience.

On Processes

Of timely interest is a new textbook —"Manufacturing Processes"—by Myron L. Begeman, professor of mechanical engineering, The University of Texas. It is intended primarily for engineering students, supplementing shop practice manuals, and may also be used as a text for industrial courses or courses without laboratory work. Subject matter is concerned with latest shop practice in the field of metal cutting, foundry, pattern work, plastics, heat treatment and welding. The book stresses the basic details of important manufacturing techniques, engineering materials, and modern production equipment. Although designed primarily for engineering students, it can be recommended as a quick reference manual on modern methods and equipment for use by engineers, production men, and others. The book is published by John Wiley & Sons, runs 579 pages, profusely illustrated.

Tool Engineering

A huge handbook on special tool items such as tap drivers, chucks, boring bars, recessing tools, turret lathe tools, etc., has been published by Scully-Jones and is ready for distribution. It is a combination of catalog and treatise on special tool design, giving full details of the types of tools made by this organization, and replete with sketches helpful to the tool engineer. We recommend it highly as an essential item on the desk of master mechanics, tool engineers, and others in the production departments. Ask us to get you the "Tool Engineering Manual—500" published by Scully-Jones.

Aircraft Engines

First edition of a new text on "Aircraft Engine Design" by Joseph Liston, associate professor, Purdue University, is just off the press. While it is intended as a text book for university students, it should be of value to engine designers as a reference work on current principles. Among the topics covered in detail as to practice and mathematical analysis are the following—gas-pressure forces, analysis of the crank chain, analysis of bearing loads, design of reciprocating parts, crankshaft vibration and balancing, valve gear, superchargers and accessories. From the standpoint of use as a text book, it has an interesting innovation in the form of an outline of "suggested design procedure" for each chapter. This is intended as a guide to the student in acquiring the technique of attacking specific problems, although the author does not claim that the procedure indicated is the only way or even the best way. Engineers concerned with the development of aircraft engines will find much of interest in this recent contribution to the literature. The book is published by McGraw-Hill.

Production Control

Stemming from notes based on industrial engineering experience, used in teaching the course in production control at the University of Minnesota, a comprehensive text book entitled, "Plant Production Control" by C. A. Koepke has been published by John Wiley & Sons. In its philosophy the book deals with production control as a basic tool in the maximum production of goods with the minimum of confusion and expense. A sampling of topics covered in the text touches chapters on such activities as—budgets, machinery replacement, economic lot sizes, use of planning records, inspection, measures of factory performance, etc. The discussion of economic lot sizes and of quality control based upon the latest developments in the field of statistical analysis are particularly timely and warrant the attention of production men. Generally speaking, although the book has been developed as a text for students of industrial engineering it should be useful to young production men as well as seasoned executives as a reference work and an index of up-to-date developments in the field.

Quality Control

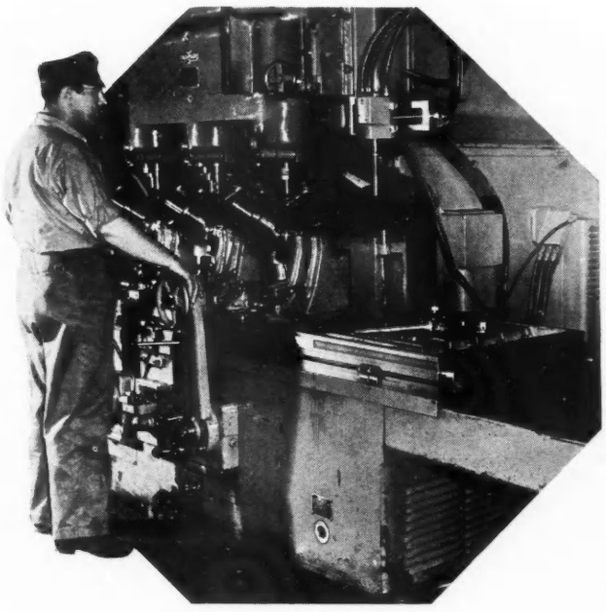
On various occasions we have touched on new techniques of statistical methods as applied to quality control. Incidence of the war has served to bring this subject to the fore what with the backing of Army Ordnance and if the situation is handled properly industry will emerge with a valuable background. In fact if this experience is as positive as many of us hope it will be, industry will be able to find a place for statistical quality control as one of the important management tools. Dr. G. C. Craig, professor of mathematics, University of Michigan, who is currently conducting special classes on quality control for inspectors, discussed the subject recently at a meeting of The American Statistical Assn. in Detroit. In has been our conviction right along that the philosophy of quality control with the aid of statistical method is sound and deserves the attention of progressive management. Use of the "control chart" method is recommended in particular. The important thing is to forget that the new idea is based upon higher mathematics. A few simple rules involving simple arithmetic operations are all that is required. Incidentally, these working rules will be found in a new manual published by The American Standards Assn.

Air Cleaner

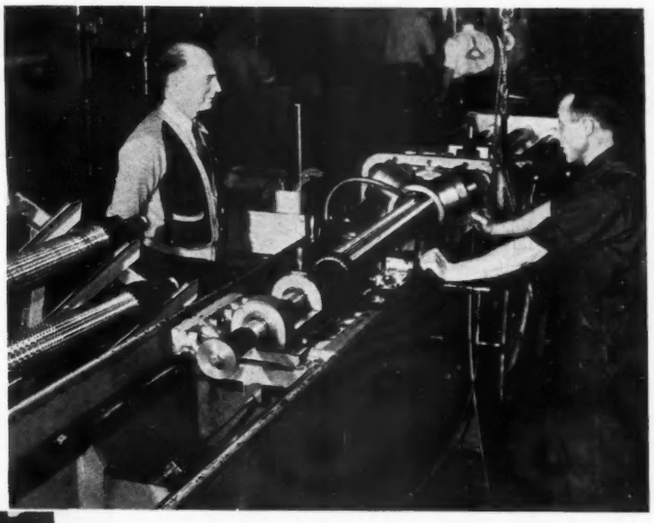
A new air cleaner, based on the principle of the paper disk edge filter, is being developed by a well-known company specializing in the manufacture of oil and fuel filters. Basic advantages of this design are said to be its compactness and self-cleaning properties. Groomed for application on vehicles of war, this air cleaner holds possibilities for motor trucks, tractors, and other normal products of the automotive industry.—J. G.

New Machines at Aeroproducts

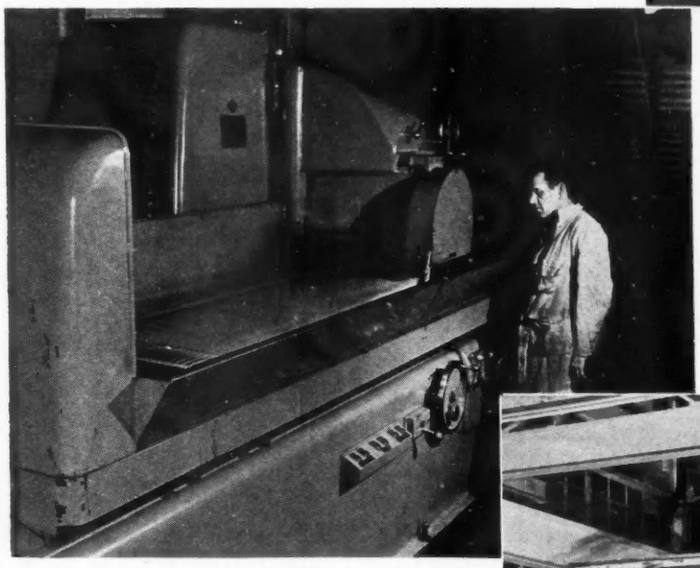
speed production of full-feathering propellers



One of the three-spindle Cincinnati Hydro-Tel machines recently introduced to speed up the machining of hubs at Aeroproducts is shown above. This machine is used for the finish-milling of the outside contour.

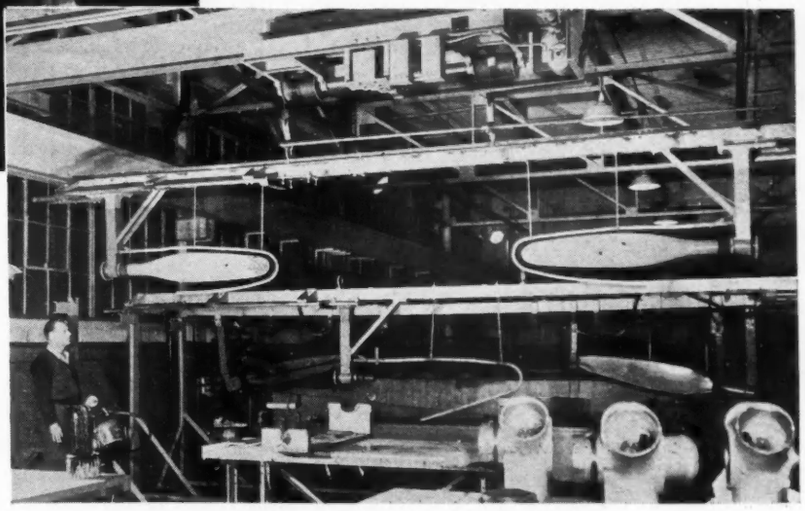


In the manufacture of an Aeroprop blade, the thin camber sheet which is ground on Thompson surface grinder is brazed to a thrust member machined from a heavy steel forging. Illustrated below.



Principal bore of the Aeroprop hub is broached to fine tolerances on new horizontal broaching machine above. It was supplied by the American Broach & Machine Co.

Aeroproducts has installed one of the finest plating departments in the industry for surface treatment of the Aeroprop blades. In the view below note the mechanized overhead carrier system and fixtures for transporting the blades through the various plating tanks.



Since the publication of the article describing the manufacturing facilities of Aeroproducts Division, General Motors Corp., in a recent issue of AUTOMOTIVE *and* AVIATION INDUSTRIES, the company has been extending its operations and adding to the production equipment. A number of the machines added recently are shown here.

*Preliminary Test of a**

Magnesium Alloy

FOR the past three years there has been increasing interest in the application of magnesium alloys to aircraft structures. In order to determine the possible weight saving and general suitability of magnesium alloys for aircraft construction, the Bureau of Aeronautics and the Dow Chemical Company has cooperated in the design, construction, and static test of a wing which was directly comparable to an aluminum alloy structure. The preliminary static tests have recently been completed, and an appreciable weight saving is indicated as shown in Table I. This paper describes the design and test of the structure and makes interesting comparisons with aluminum.

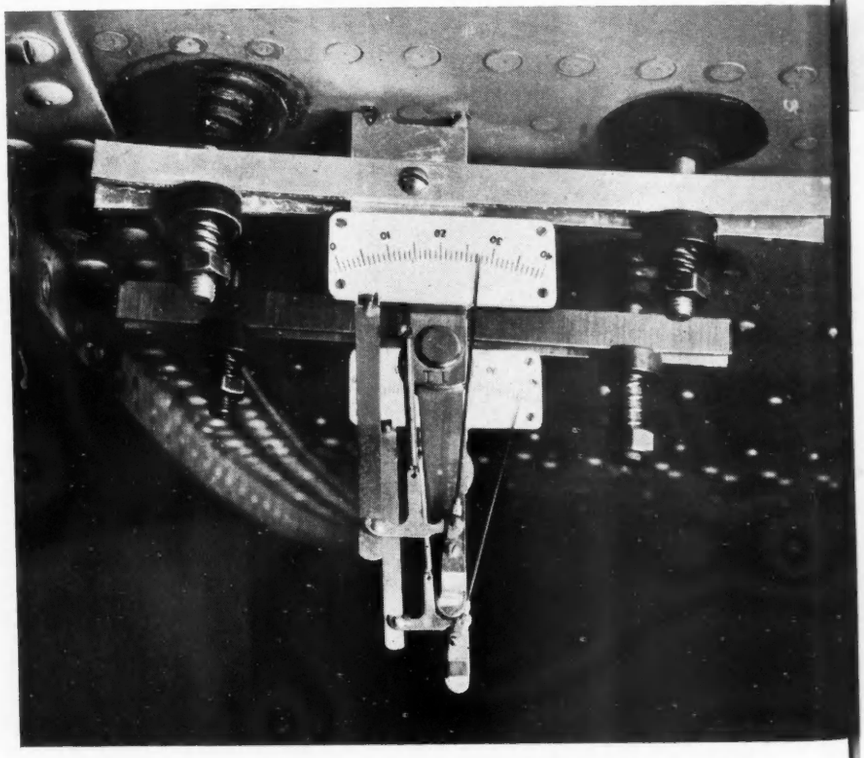
Following these static tests, a period of flight testing on several sets of wings will determine the ability of the magnesium to stand up under various service conditions. Generally speaking, the material is going through the same development cycle as aluminum alloys, with similar difficulties in forming, surface protection, etc., as were experienced in the early days of aluminum airplane development. Service tests may indicate the need for modifications in detail design or improvement in the alloys.

For this particular test the wing was designed assuming that it was attached to a foundation of infinite rigidity, but provisions were incorporated for adding reinforcements where stress concentrations became apparent during static test. Strain gages were used to determine the actual stress distribution under load and suitable reinforcements were added before any permanent set occurred in the structure.

A magnesium alloy outer wing panel was designed for one of the North American low-wing monoplane trainers. The outer panel is of the conventional semi-monocoque construction with a single main shear web located at 30 per cent of the chord. The center section has two shear webs with the fuel tanks mounted between these webs. The outer and center panels are joined by external bolting angles, and a plate rib at this point distributes the shear from the single web of the outer panel to the two shear webs of the center section.

On the experimental Dowmetal outer panel, the main shear web consists of a tension field web of Dowmetal J-1 alloy attached to "T" shaped flanges extruded from Dowmetal Z-1 alloy. The skin is cold rolled Dowmetal J-1 sheet stiffened by Dowmetal Z-1 bulb angle and Zee extrusions. The ribs, trailing edge, and wing tips were hot formed of Dowmetal J-1 alloy. The completed wing weighed 178.95 lb. as compared to 219.82 lb. for the aluminum panel; a saving of 18.7 per cent.

The outer wing panel was first mounted on a rigid jig and tested to the design or yield load. The wing was then mounted on the regular aluminum center section and loaded to the apparent yield point. In the latter test the center section was attached to a cradle, and a boom was attached to the farther side of the center section to simulate the opposite outer panel. More difficulty was experienced from this boom causing concentrated loads in the center section than with the experimental wing.

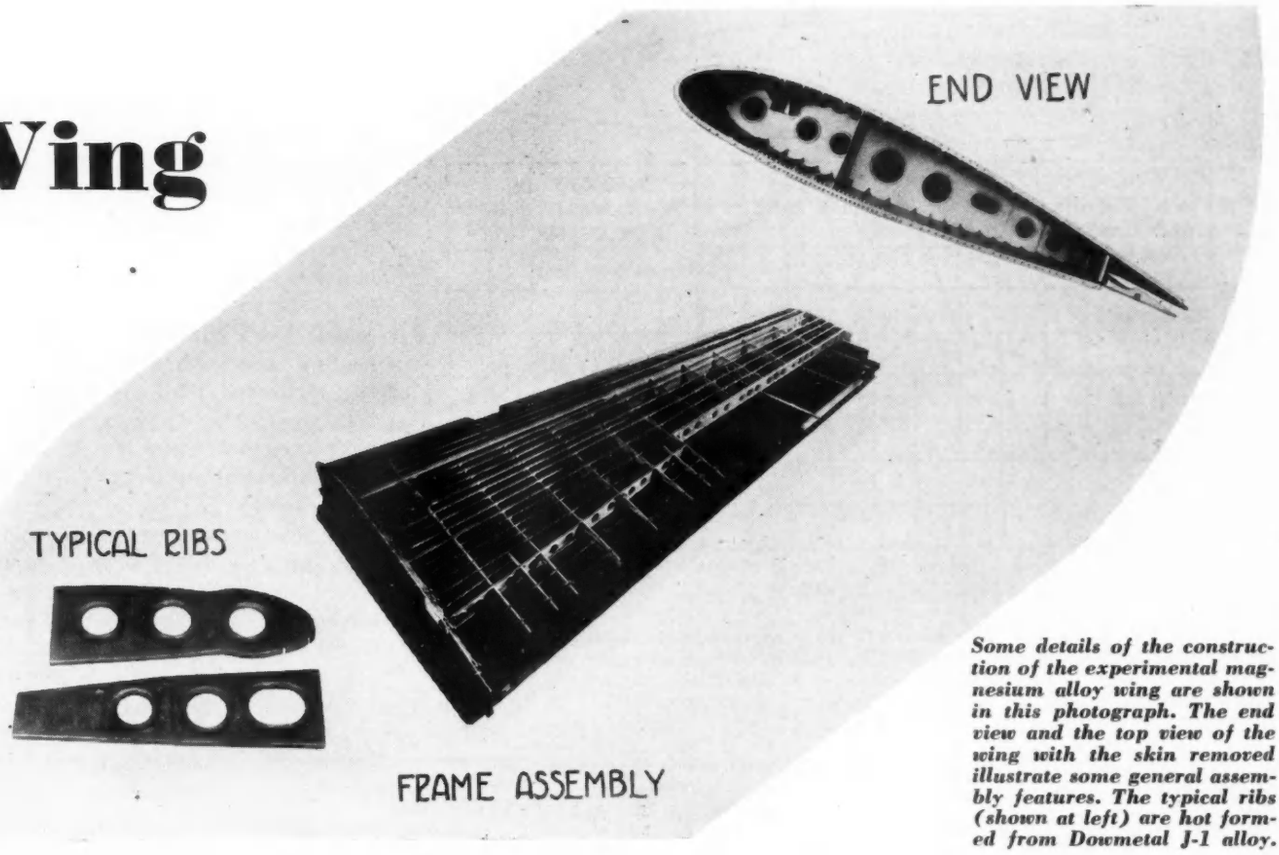


Huggenberger Strain gages were mounted on the test panel to measure the compression strain. The two gage points directly above the dial make no contact with the wing covering but bear on hardened steel screws set flush with the extrusions.

Huggenberger strain gages were mounted as shown above to measure the compression strain in the

* Abstracted from a paper presented at the 1942 Annual Meeting of the Institute of Aeronautical Sciences by Emerson W. Conlon, Associate Professor, University of Michigan, and John C. Mathes, Engineer, Dowmetal Division, The Dow Chemical Co., Midland, Mich.

Wing



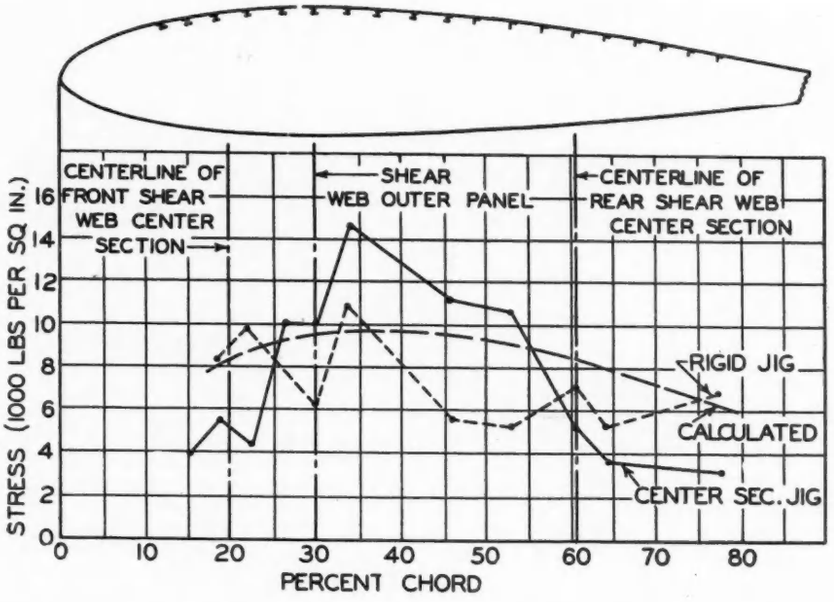
Some details of the construction of the experimental magnesium alloy wing are shown in this photograph. The end view and the top view of the wing with the skin removed illustrate some general assembly features. The typical ribs (shown at left) are hot formed from Dowmetal J-1 alloy.

extrusions independent of any distortion in the wing skin. A hole of sufficient size to clear the end of the strain gage was drilled in the sheet, and a slightly smaller hole was tapped in the extrusion. A headless, No. 6 steel screw was screwed into the extrusion, flush with the surface, and the strain gage rested on a pair of these screws. This method was used to prevent the hardened end of the strain gage from penetrating the surface of the softer extrusion and thus causing erroneous readings.

The variation in stress distribution at the root, with the wing mounted on a rigid end plate as compared

TABLE I—COMPARATIVE WEIGHT STATEMENTS OF MAGNESIUM AND ALUMINUM WING PANELS

Item	WEIGHTS (Lbs.)		Material
	Aluminum Wing	Magnesium Wing	
Beam (Main)	17.80	13.85	J-1H Sheet and Z-1 Extrusion
Beam (Auxiliary)	3.80	3.10	J-1H Sheet
Ribs	13.25	11.83	J-1H Sheet
Trailing Edge	1.90	0.95	J-1H Sheet
Bolting Angles	5.95	5.95	Aluminum
Fittings	1.65	1.93	
Stringers	38.60	29.62	Z-1 Extrusions
Gussets	2.90	1.94	J-1H Sheet
Landing Gear Attachment Fitting	2.20	1.64	J-1H Sheet
Electrical Equipment	3.50	3.50	
Rivets, Bolts, etc.	9.00	10.35	Aluminum and Steel
Metal Covering	78.30	55.82	J-1H Sheet
Paint	2.00	5.73	
Inspection Windows	3.25	3.69	
Hoisting and Mooring	0.40	0.54	
Total Weight of Wing	184.50	150.44	
Aileron and Balance	23.50	18.04	J-1H Sheet
Flap	7.00	5.65	J-1H Sheet
Controls	4.82	4.82	
Total Weight of Assembled Panel	219.82	178.95	



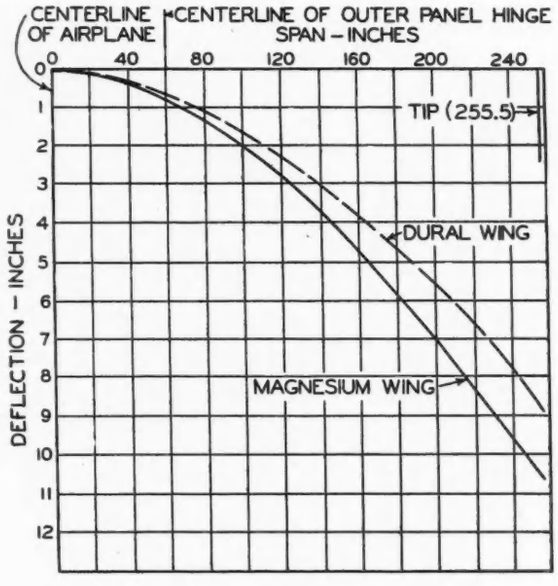
In this graph the stresses at 60 per cent proof load with rigid mounting are compared with the stresses set up with the wing fastened to a center section jig.

with the wing mounted on the regular center section, is of special interest. The graph above shows the measured stress distribution in both cases at 60 per cent of proof load. In general, the rigid end plate produced a stress distribution consistent with the calculated values, while the center section caused a sharp increase in the stresses in the center portion of the wing, but lower stresses at the leading and trailing edges. It is of interest to note that the point of maximum stress remains unchanged and is located 3 in. aft of the main shear web on the outer panel. The higher stresses at the leading edge, when mounted on the rigid end plate, necessitated reinforcements which would not have been necessary if tested on the center section alone.

The rigid end plate test was made first and carried to 100 per cent proof load. The wing was then tested on the aluminum center section. During this test, the sharp increase in stress at the 34 per cent chord point made it evident that the structure would not withstand the full design load without reinforcement. Five stringers of appoximately 15 in. in length were added, and the maximum stress was reduced from 15,000 lb. per sq. in. to 10,000 lb. per sq. in. at 60 per cent proof load.

TABLE II—DOWMETAL Z-1 ALLOY EXTRUSIONS

	Tensile Strength, lb., sq. in.	Tensile Yield Strength, lb., sq. in.	Comp. Yield Strength	Per Cent Elong.	Brinell Hardness
Extruded bars up to 1½" Dia....	55-65,000	40-50,000	28-35,000	6-8	90-95



Spanwise deflection at main spar (30 per cent chord) for a low angle of attack at proof load. Both outer wings were mounted on the same dural center section.

The normal deflection of both the aluminum and magnesium alloy wings is shown below at left. The tip deflection of the experimental magnesium wing under 100 per cent proof load was 10.75 in. whereas the deflection of the aluminum alloy wing under the same load was 8.8 in. The increase in deflection corresponds with the decrease in structural weight. This is in agreement with theory, since, if the aluminum and magnesium wings were of the same weight, the cross sectional area of the magnesium wing, and the moment of inertia as well, would be $\frac{0.101}{0.065} = 1.555$ times that of the aluminum section. Since the deflection of the wing varies inversely as the product of the modulus of elasticity times the moment of inertia, the ratio of *EI* of magnesium to the *EI* of aluminum gives the ratio of the deflections of the respective wings.

$$\frac{EEI \text{ (Magnesium)}}{EEI \text{ (Aluminum)}} = \frac{6.5 \times 10^6 \times 1.555}{10.3 \times 10^6 \times 1} = 0.98$$

and the two structures would have about the same deflection.

In the case of this experimental wing:

TABLE III—DOWMETAL J-1H ALLOY SHEET
Navy Aeronautical Spec. M-111-F, Alloy 8
Army Air Corps Spec. 11317

	Tensile Strength, lb., sq. in.		Yield Strength, lb., sq. in.		Comp. Yield Strength Typ.	Per Cent Elong.		Typical Bend Radius
	Typ.	Min.	Typ.	Min.		Typ.	Min.	
Hard Rolled Sheet to ¼"	45,000	40,000	35,000	28,000	24,500	8	3	7

$$\frac{\text{Deflection (Magnesium Wing)}}{\text{Deflection (Aluminum Wing)}} = \frac{10.75}{8.8} = 1.22$$

$$\frac{\text{Weight (Aluminum Wing)}}{\text{Weight (Magnesium Wing)}} = \frac{219.82}{178.95} = 1.23$$

It may be concluded that the weight saving, due to substitution of magnesium for aluminum, will result in an increase of bending deflection of the same relative magnitude.

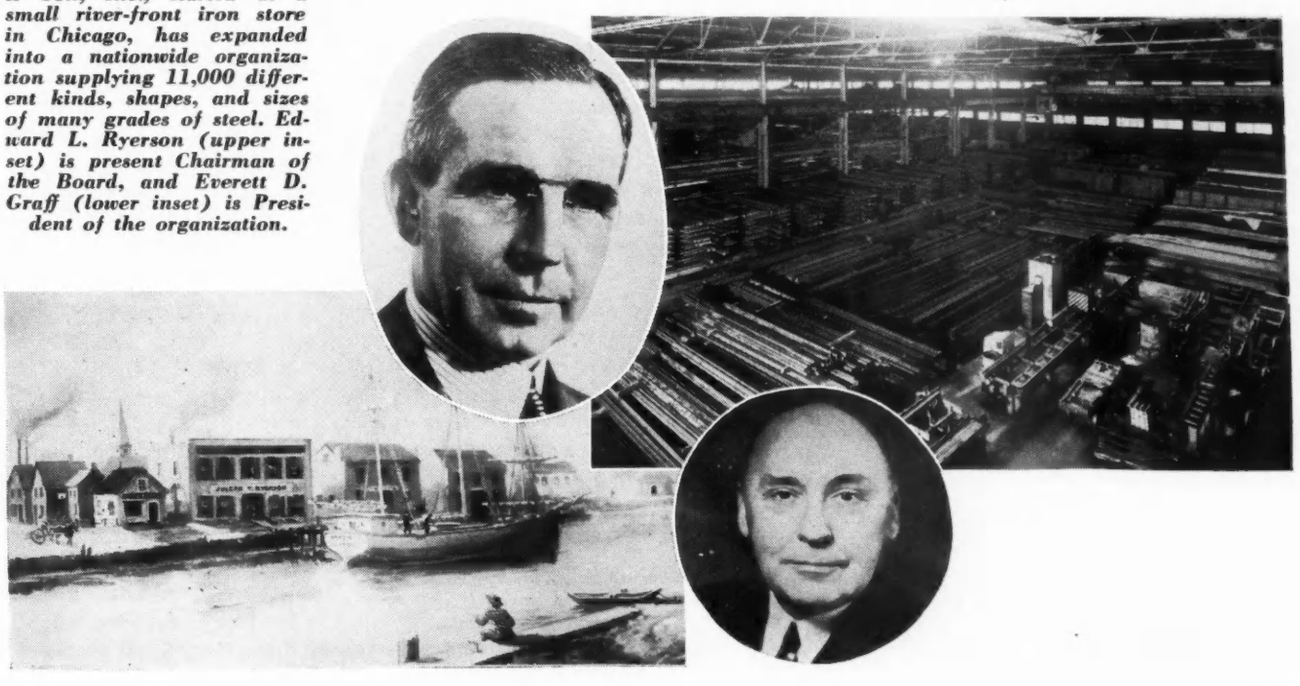
As would be expected, the lighter experimental wing has less torsional rigidity and more torsional deflection. The critical flutter speed was calculated theoretically to determine whether the decrease in both bending and torsional rigidity would produce a dangerously low critical flutter speed. The calculations indicated that since both the torsional and bending rigidity decreased, there was little change in the critical flutter speed.

Based on ultimate strength, the theoretical weight saving for flat and curved sheets of magnesium alloy is approximately 20 per cent. It is somewhat more difficult, however, to obtain a theoretical value for the weight that can be saved in conventional semi-monocoque design. Compression tests have shown the actual weight savings to be of a magnitude similar to the theoretical values for flat and curved sheet. Nevertheless, it is impossible to realize this entire weight savings in a complete assembly. The various fittings and items of equipment which are not changed reduce the percentage of weight reduction obtained. Corner gussets and reinforcements or doublers at points of stress concentration, etc., are more necessary with magnesium than with aluminum, and some weight is also lost in these added reinforcements. In the case of the magnesium wing panel discussed in this paper, the weight saving of 18.7 per cent is near the top limit possible.

Of equal interest with the weight saving possibilities, is the utilization of magnesium and its low specific gravity in the design and construction of more nearly pure monocoque assemblies. The savings in cost, the added space in the structure for armament, equipment, or tanks, and the smooth surface obtained are all pertinent considerations which indicate the desirability of this development.

Joseph T. Ryerson & Son, Inc., Celebrates Its 100th Anniversary

Celebrating its 100th Anniversary, Joseph T. Ryerson & Son, Inc., started as a small river-front iron store in Chicago, has expanded into a nationwide organization supplying 11,000 different kinds, shapes, and sizes of many grades of steel. Edward L. Ryerson (upper inset) is present Chairman of the Board, and Everett D. Graff (lower inset) is President of the organization.



The Strain Gage as an Aid in

AN INTERESTING and valuable development in the field of instrumentation is the strain gage, by means of which small deformations due to loading of mechanical members are measured. These small deformations are generally referred to as strain. From Young's law we know that in elastic material the strain is proportional to the stress, and the ratio between the two has long been known as Young's modulus, though today we refer to it more commonly as the modulus of elasticity. If this modulus is known for a given material and the strain in the material under load is measured, then the stress at which the material is being worked can be readily calculated.

Perhaps in no other branch of industry has the strain gage proved so useful as in the development of aircraft structures. Useless or unnecessary weight cannot be tolerated in such structures, and in order to eliminate it, stresses in the various parts must be either accurately calculated or else determined experimentally. Many parts are of such irregular form and subjected to such complex stresses that calculation is almost impossible. In such cases the designer resorts to the strain gage and makes experimental determinations. The strain gage, says C. R. Strang, chief strength engineer of the Douglas Aircraft Co., Inc., in a report to the Society of Automotive Engineers, serves to substantiate decisions made by the structural designer in the past and furnishes him with information which will enable him to make better decisions in the future. Mr. Strang deals with the electric strain gage, which comprises resistance units that are cemented to the strained part, together with amplifying and recording apparatus by means of which strains under dynamic load, as in actual flight, can be recorded. The resistance units have been fully described in NACA Technical Paper No. 744 by deForest and Leaderman. The amplifying and recording apparatus was developed by the Douglas company.

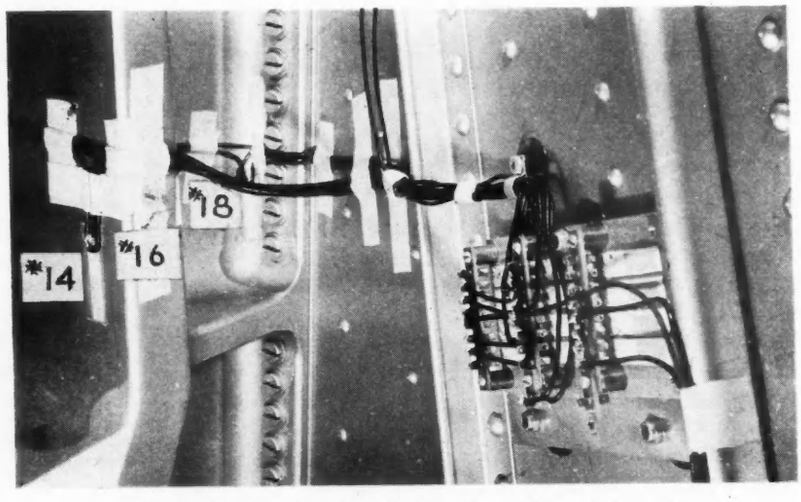


Fig. 2—Strain gage installed on large forged I section

The equipment consists of resistance units of fine wire cemented to the stressed surface under investigation and connected in a suitable bridge circuit. The cross section, and hence the resistance of the gage units, is varied by elongations or contractions to which it is subjected. The resulting unbalance of the bridge circuit is amplified by electronic means, and recorded by equipment suitable to the nature of the tests. A recording oscillograph is used if the tests are dynamic in nature; a stylus recorder, or even a simple meter, is used if the stresses involved are static.

Current structural theory in many instances has been verified by the use of mechanical strain gages of one kind or another. Such gages, unfortunately, require a highly developed technique. As a rule, good results are obtained with them only by highly trained personnel under very favorable laboratory conditions. In practical work on aircraft, the odd sections to which gages must be attached, lack of room for their installation, the rapid variation of stresses in flight, and the importance of stresses in thin sheet working in the wave state combine to limit the use of such gages. Electric gage units, on the contrary, are very small and suffer from none of the foregoing disadvantages.

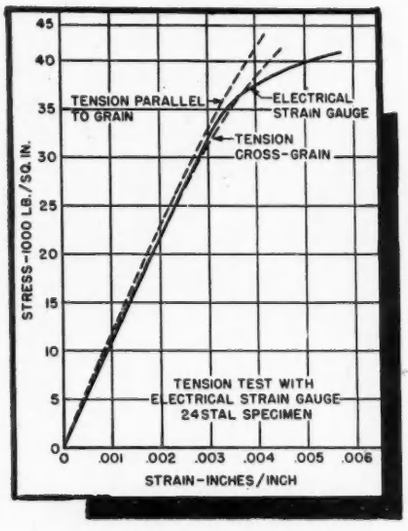


Fig. 1 — Stress-strain diagrams plotted from results obtained with electric strain gage and by other methods

In addition, when used with suitable associated apparatus, they are remote-reading and self-recording. There is a special method of use of the gage unit for each type of stress, best adapted to that particular type.

In work of this kind it must always be remembered that a strain and not a stress is being measured, and Poisson's-ratio corrections must be applied wherever there are stresses not parallel to the axis of the gage. With simple axial loads and uniform stress distribution over the entire section, a single gage would give the correct stress. Such a fortunate state of affairs rarely exists, and it is much better to use a number of gages so interconnected that an average of the stresses imposed on all of them is read. By this method a true indication of the average axial stress and of the true axial load in the member may be obtained.

In the case of pure axial stresses parallel to the gage axis

$$\text{Stress} = E \times \text{Strain}.$$

In Fig. 1 a stress-strain curve obtained with the electrical strain gage is compared with two similar curves based on measurements made with more conventional equipment. At stresses above 37,000 psi the electrical gage indicates a much more rapid increase in strain than should be expected, and the useful range of the electric gage therefore is taken to be of the order of 0.0037 in. per in. strain. It follows that the gage limit for dural = 10,000,000 × 0.0037 = 37,000 psi, and the gage limit for steel = 29,000,000 × 0.0037 = 107,000 psi.

For investigations on the more-highly heat-treated steels, it is sometimes possible to widen the apparent useful range by taking advantage

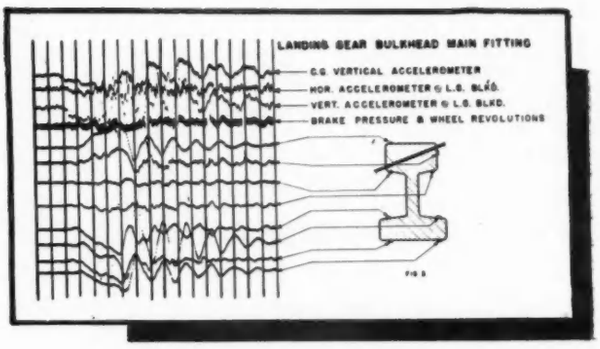

LANDING GEAR BULKHEAD MAIN FITTING
C.G. VERTICAL ACCELEROMETER
HOR. ACCELEROMETER @ L.G. BLKD.
VERT. ACCELEROMETER @ L.G. BLKD.
BRAKE PRESSURE & WHEEL REVOLUTIONS

Fig. 3—Strain records taken from I section together with some other records made simultaneously

of preload stresses. For instance, in a typical Investigation of a landing-gear axle for a large airplane, for which the ultimate design load factor might be four, the axle could be steel, heat treated to 180,000 psi and worked at the ultimate load factor to an allowable modulus of rupture of the order of 250,000 psi. In that case, the airplane simply parked on the ground, fully loaded, would be experiencing axle stresss as high

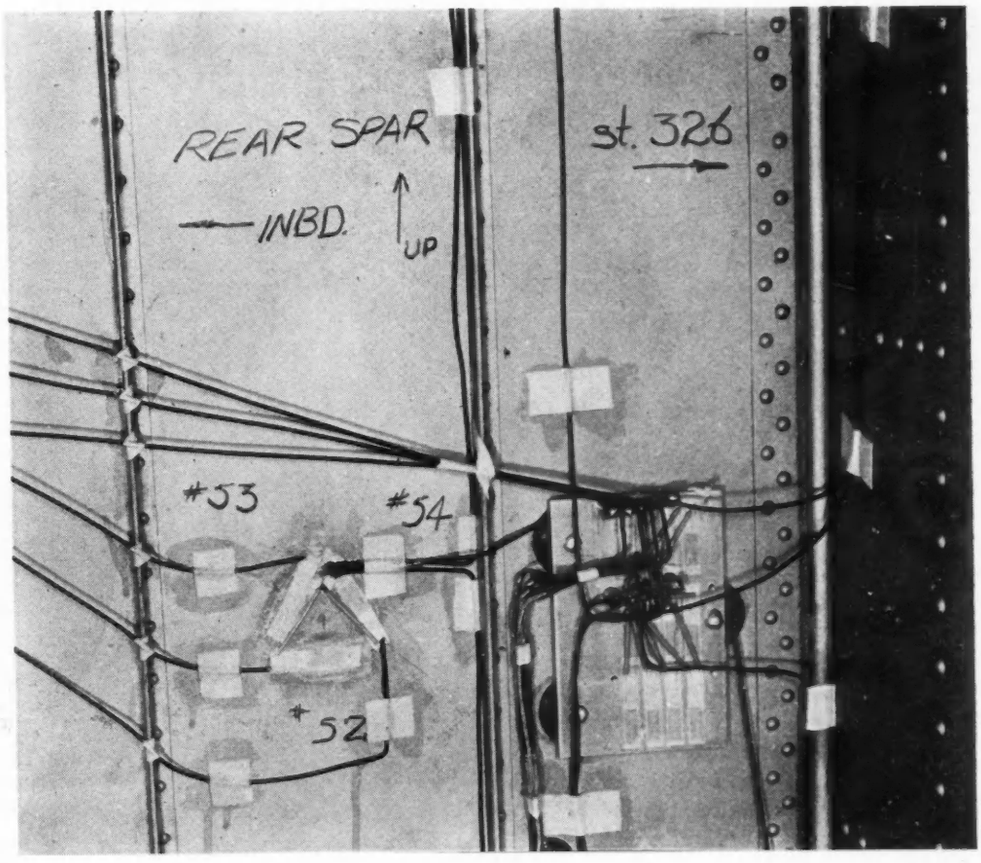


Fig. 4—Installation of electric strain gage on spar web

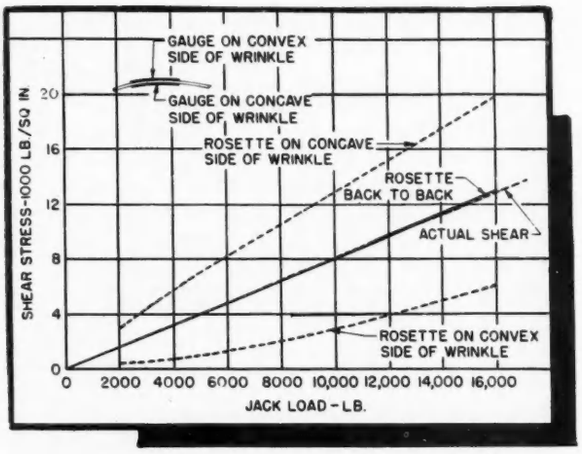


Fig. 5—(Above) Shear stress vs. applied load as indicated by gages on convex and concave sides of wrinkle, and true value of shear

as 250,000/4 = 62,500 psi. A gage installed at a point so stressed would not be overstressed when the load was removed, as in flight. In such a case, if a landing were made at the expected applied-load factor, 4/1.5 = 2.667, the increment of stress imposed on the gage would be (2.667/4) × 250,000 = 104,000 psi. This would still be within the permissible working range of the gage.

Where non-uniform stress distribution is known to exist, and it is desired to determine that distribution, a number of individual gages located at critical points may be used. From these data, a plot of the stress distribution across the section may be made, and bending and direct stresses then may be isolated.

One such case is illustrated by the arrangement used to determine the stress distribution across the unsymmetrical I section of an extremely large, forged fitting, part of which is shown by Fig. 2. Pickups were distributed as shown in Fig. 3, together with a section of the record taken during a landing. For convenience, these circuits usually are so arranged that tensile stresses are indicated by an upward swing, compressive stresses by a downward one. The vertical lines are time lines, each division representing one-tenth of a second. Redistribution of bending stress due to beam curvature has been investigated with a similar installation.

When bending stresses alone are under investigation, it is possible to use one gage on each side of the bending member, the two being connected in a single circuit, so that the total stress differential (the combination of tension on one side and compression on the other) is indicated. Such applications give highly accurate results, because two gages are used and are included in opposite legs of the "bridge."

Shear Stresses

When the direction and magnitude of the principal stresses are unknown, it is always possible to determine the complete state of stress on a surface if a sufficient number of strains in different widely-divergent directions are known. Methods of determining the state of stress from such data were developed originally for use with mechanical gages.

The use of so-called strain deltas (three resistance members installed on the test piece at 60 deg. with each other) has become standard practice for determining stresses in thin sheet. A typical installation on air spar web is shown in Fig. 4. In aircraft work such sheets generally operate in the wave state. The additional bending stresses imposed by buckling of the sheet are surprisingly large, and the effect of such large bending stresses is to render the indications of a delta, attached to one side of the sheet only, very unreliable so far as average conditions are concerned. For that reason, unless it is known that buckling will not occur, deltas are invariably installed with gages back to back. Each leg of the delta then is connected with its counterpart on the opposite side of the sheet, to read an average stress which cancels out the additional bending stress due to wave formation. Fig. 5, which is based on tests conducted to investigate these points, illustrates them very well. Note the wide divergence in shear stresses indicated by the surface stresses on one side of the sheet only. by comparison with either the delta on the other side or with the known overall shear. The actual shear is accurately checked by the back-to-back arrangement.

While the orientation of the strain delta should be

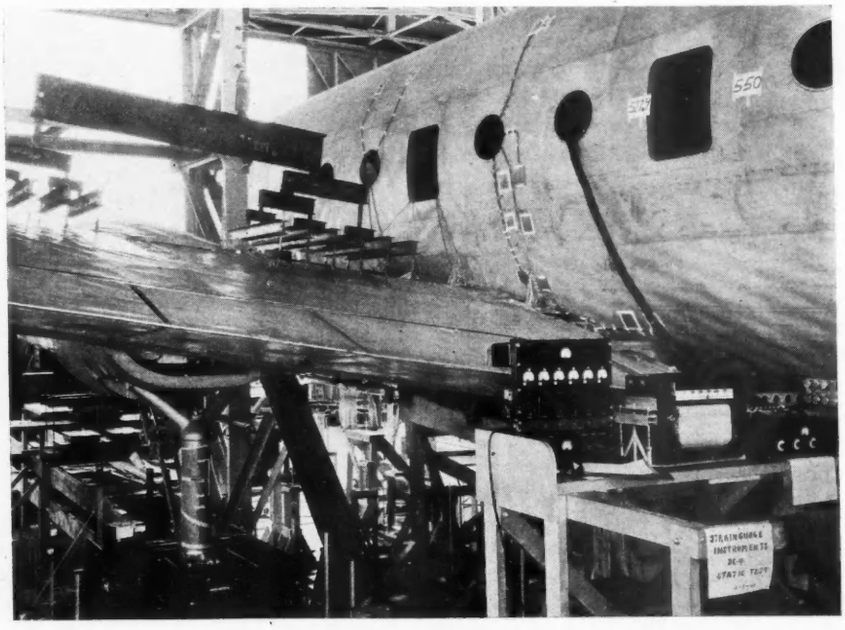


Fig. 6—(Right) Set-up and amplifying and recording apparatus for static tests on a complete airplane at Douglas plant

known, tests have shown that the accuracy is not affected by orientation with respect to the principal stress directions. Some gain in accuracy is achieved by installing the three gages forming the delta in as small a pattern as possible. Dummy gages are provided for all except total bending differential applications. The need for dummy gages is due to the fact that in the bridge circuit it is necessary to balance the resistance of the gage unit itself against an identical resistance, and the easiest and most satisfactory way is to use another gage. Besides, temperature compensation can be achieved most satisfactorily if the extra dummy gage is mounted on metal having the same composition as the metal on which the stress determination is being made. In addition, it is necessary that the extra dummy be mounted on metal which is not stressed. In Fig. 4 the dummy gages for the strain delta are shown mounted on a separate piece of metal so supported that no stresses can be transmitted to it from the web.

The methods discussed in the foregoing are applied in static tests of complete airplanes—often very large ones—and in tests made during flight. In such cases the wiring between the gage units themselves is cheap, but it is necessary to limit the number of channels used, so that not too much installation wiring will be required. Furthermore, in flight testing the number of channels available simultaneously is sharply restricted. Problems under investigation often must be broken down into phases which can be handled one at a time with the equipment available. Means must then be provided to switch from one phase to another when, as often happens, more than one phase must be covered during a single flight. Fig. 6 is a photograph of the installation of the amplifying and recording apparatus set-up during a static test of a complete airplane. In this case, cables and all the wiring from all the gages installed all over the airplane have been brought to a stand conveniently set up outside of the airplane. The unit to the left is a six-channel amplifier with its associated meters. The center instrument is a Brown electronic potentiometer, which is used to record indications from some 300 strain gage installations. This instrument incorporates an electronic amplifier and a high-speed self-balancing bridge system. A switch panel is shown to the right, which permits selection of any one of the 300 channels. For flight test work, an installation similar to that shown in Fig. 7 is typical. The rapidly varying nature of the stresses, and particularly the short duration of the peak stresses (which are most important), makes it necessary to record the results with some form of recording oscillograph. In the Douglas plant a 12-channel Miller oscillograph is used. In this case a 12-channel amplifier and a 12-channel Miller oscillograph are shown installed in the XB-19, this equipment being adapted for the recording of dynamic loads, while the installation shown in the two preceding photographs is suitable only for static test work.

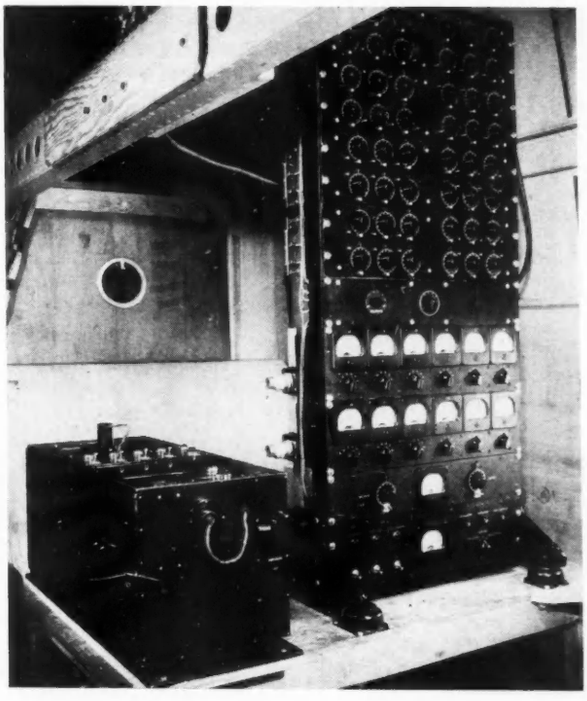


Fig. 7—Apparatus installed on plane for making records of strains during flight

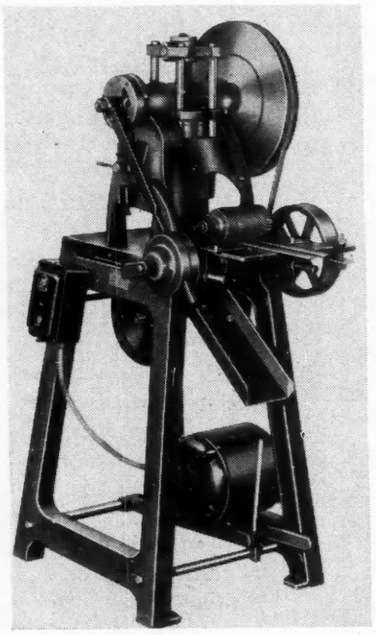
Various other uses may be made of the equipment described, simultaneously with stress determinations. For instance, very reliable accelerometer pickups, which function as an inductance bridge just as the strain gages function as resistance bridges, have been developed and may be used simultaneously with the strain gages. Also, both the accelerometers and the strain gage units are ideal vibration pickups, and they interchangeably and simultaneously record vibration frequencies and their relative amplitudes. Moreover, a little ingenuity will make the same instrumentation supply much additional essential information. For instance, pressure variations in a hydraulic line may be recorded, due to the expansion and contraction of the line, which is picked up by a strain gage cemented around it; or the rotational speed of the landing wheel may be recorded by providing suitable contact points on the wheel and superimposing the record on a channel which is already being used for some other purpose, as in Fig. 3. Spatial relations may be measured by suitably forcing the deflections of a simple cantilever beam which is equipped with bending strain gages and is calibrated in terms of the deflection of the beam.

Since the introduction of the Rzeppa constant velocity universal joint, some years ago, by The Gear Grinding Machine Co., Detroit, Mich., this unique joint has found application in a variety of military and non-military equipment.

Most recent development is an expansion in the range of joint sizes (15/16 to 3 in.).

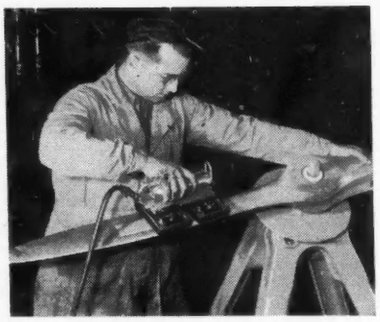
MEN and

A NEW automatic shell coating machine, manufactured by the Binks Mfg. Co., Chicago, Ill., is especially adapted to the spraying inside and out of 75- to 105-mm shells at the rate of 200 to 500 per hour. In operation, shells carried in especially designed work holders fastened to a conveyor pass into the spray booth where both the inside and the outside of the shell are painted as the work holder is rotated.



The Diebel Hi-Speed stamping press is recommended for the production of small stampings from metal, fibre and plastics at speeds up to 500 pieces per minute

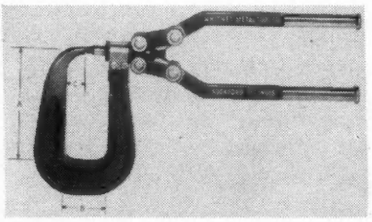
FASTER production and economy of operation are claimed for the Diebel Hi-Speed stamping press manufactured by the Di Machine Corp., a division of the Diebel Die & Mfg. Co., Chicago, Ill. Driven by a ¾-hp, 220-v, 60-cycle, 3-phase motor running at 1725 rpm, the press can be operated at 180, 370, or 500 strokes per minute. It will handle either strip or coil stock.



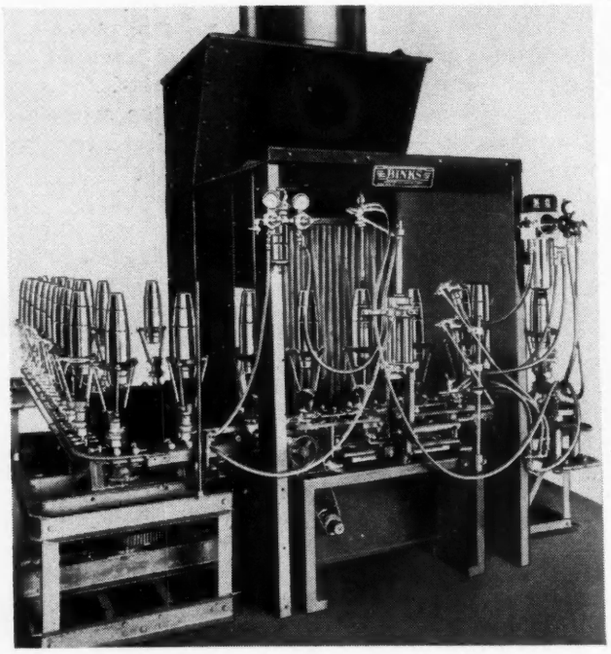
The Sundstrand Model 3000-F opposed-pad sander is especially adaptable to the sanding of wooden propeller blades. Carrying two pads measuring 3 2/3 by 7 in., the machine operates at a speed of 3000 oscillations per minute on an air pressure of 50 to 80 psi. Built by the Sunstrand Machine Tool Co., Rockford, Ill., the sander is said to be entirely free of vibration

THE new Ernst drum and barrel carrier, built by the Ernst Magic Carrier Sales Co., Buffalo, N. Y., is designed to handle light wood, fiber, and paper barrels, and "one-trip" light-gage steel containers with or without chimes. With a capacity of 800 lb, the carrier can be operated easily by one man. After the clamp has been attached to the drum, a simple downward movement of a lever lifts the drum several inches off the floor. The container can then be transported with ease.

ONE OF the methods now being used by some companies to save time and often materially simplify precision assembly operations is the use of "Oildag" for coating mating surfaces prior to fitting or assembly. A specific example is in its use in assembling and breaking in of airplane engines. Many aircraft engine parts have to be manufactured to extremely close limits. These parts are then usually sorted according to variations in size, in steps of a few ten-thousandths of an inch. This is

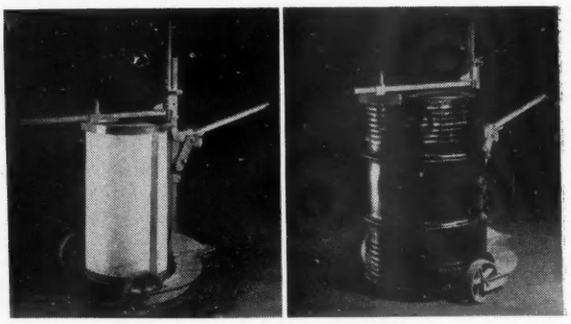


The standard tool in the Whitney-Jensen line of aircraft rivet squeezers, this device can be furnished with jaw openings ranging from ⅞ to 2 3/16 in. It is designed to set ⅛ in. aluminum rivets. Other models are furnished with different jaw designs to handle many types of work



Binks automatic spraying machine for 75- to 105-mm shells

The Ernst drum and barrel carrier has a capacity of 800 lb.

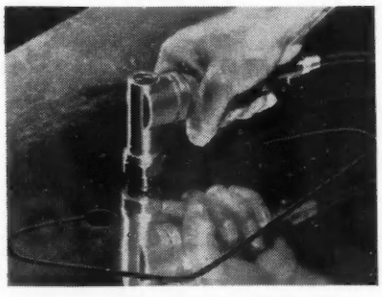


MACHINES

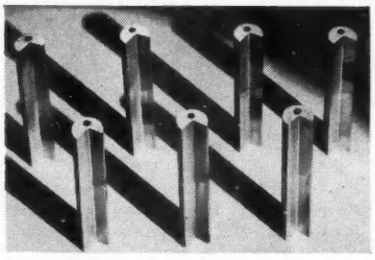
followed by selective assembly to similarly close tolerances for the fits of mating parts. In such cases, parts which might otherwise gall from metal-to-metal contact during their initial operation in test or service are now being assembled with mineral oil carrying a colloidal graphite dispersion. This procedure reduces the possibility of abrading the surfaces when fits are extremely close or where the tolerances tend to run on the "tight" side.

The procedure also offers an opportunity of reducing the number of "stepped" sizes as well as the number of selections necessary to obtain the desired fit between mating parts.

FLEXIBLE shaft units with 45- or 90-degree heads are built by the Stow Mfg. Co., Binghamton, N. Y., for direct connection to an electric drill chuck. Both heads gear-driven, ball-bearing mounted, and permanently attached to the flexible shaft. Spindle heads are threaded for adapters accommodating either stub or full-length drills up to No. 30. The clearance distance from the drill center to the outer surface of the angle head housing is ⅜ in. These heads are also available without the flexible shafts for direct connection to a drill chuck.

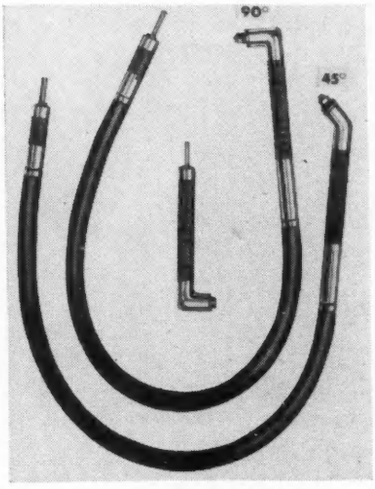


The Desoutter "Nibbler" can be used to cut any required shape in light sheet metal.



Carboloy-tipped rifle drills according to the manufacturer, are capable of producing an average of two dozen 50-caliber barrels per grind of the tip

A PORTABLE pneumatic tool extensively used in British plants and having special appeal in aircraft production is the Desoutter "Nibbler," made by Desoutter Brothers, London. It is distributed in the United States by the Buckeye Portable Tool Co., Dayton, O. As shown in the accompanying photograph, its prime purpose is to cut apertures of any required shape in light metal sheet or previously erected panels. It consists of a small punch and die which can be turned in a radius as small as 1 in. The punch operates at 2500 strokes per minute, the "nibbles" overlapping to leave an exceptionally smooth edge. It weighs only 2 lb., consumes air at the rate of 9 cu ft per min, has a cutting speed of 10 ft per min through 18 gauge light sheet, and is controlled by a push-button arranged for operation by the palm of the hand. To cut out any internal shape, it is necessary merely to drill or punch out a hole of 1 in. diameter through which the head of the "nibbler" can be inserted. Besides irregular shapes, circles can be cut to close limits with the aid of a specially devised graduated arm attachment.



Stow angle heads facilitate the drilling of small holes in out-of-the-way places. They can be furnished with or without a 30-in. flexible shaft.

WITH the completion of experimental production runs resulting in an increase of 1/3 to ½ in the output of drilled gun barrels per man-hour and machine-hour, Carboloy tipped rifle drills for 30- and 50-caliber and 20-mm gun barrels have been placed in production by the Carboloy Co., Inc., Detroit, Mich. The new drills are furnished with the Carboloy tip brazed to a short steel shank which in turn is attached by the users to their regular gun drill tubes. Cutting edges are not finish ground, since experience has shown that optimum angles, etc., will vary among different plants. Final cutting edges are therefore ground by the individual user.

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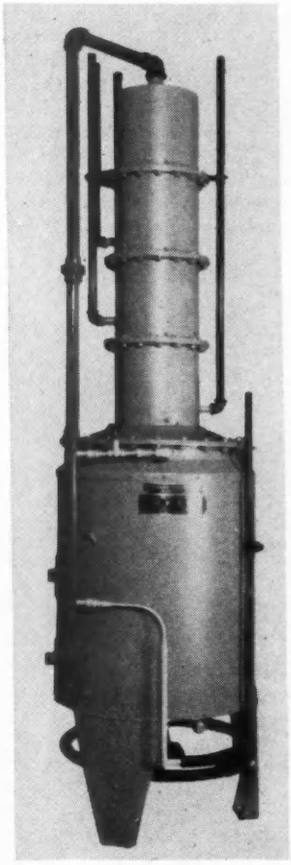
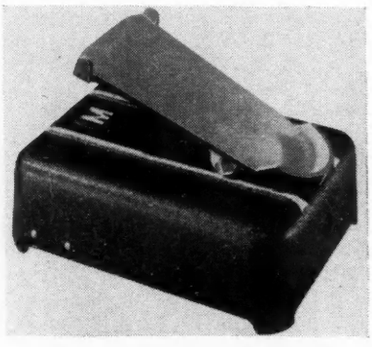


The concentrator shown in the photograph is part of the Niagara "No-Frost" system which is used to produce constant room temperatures down to minus 80 F. Designed for use in plants and experimental laboratories, the new equipment manufactured by the Niagara Blower Co., New York City, gives constant operation without interruption or loss of capacity caused by the formation of frost on the cooler coils. A three-stage system effects the removal of humidity and the depression of room temperature. It employs a special non-freezing liquid which is continuously reconcentrated in the concentrator

THE Arctol welding controller, manufactured by the Mullenbach Electrical Mfg. Co., Los Angeles, Cal., is a foot-operated, variable resistance unit designed to vary the excitation current of various standard makes of d-c welders. Each unit, housed in a heavy cast-iron base, is designed to match the saturation curve of the welding generator with which it is to be used. It can be plugged into the generator to replace the original resistance, or it can be placed in series with the voltage control rheostat on the welder. Through its use the crater which is formed so frequently at the end of a weld can be eliminated by operating the control to taper off the current to zero.

A RECENTLY introduced hydraulic forming and flanging press, built by the Beatty Machine & Mfg. Co., Hammond, Indiana, is furnished in capacities up to 400 tons. An interesting design feature is the hydraulic oil circuit which is so arranged that the two 200-ton-capacity vertical cylinders can be tied together and operated as a single 400-ton unit. When used for flanging, the front cylinder advances to the work and holds the work while the horizontal ram advances. The stroke of the cylinders is 24 in., the depth of the throat is 66 in. from the center of the vertical cylinders, and the table is 48 in. wide by 88 in. deep.



Arctrol Welding Controller

AN exhaust gas tester, designed and built for test-stand use in the automotive and aviation industries, has been announced by the Cambridge Instrument Co., Inc., N. Y. Furnished complete with sampling nipples, hose connectors, and copper tubing, the instrument is fitted with two scales, one showing the fuel-air ratio, and the other the air-fuel ratio. Operation of the instrument is based on the well-known thermal conductivity principle of gas analysis. In use the maximum speed of response can be obtained by locating the analysis cell near to the engine. The indicator, however, can be located at any distance from the engine since it is electrically operated.

PENCILTEX, an anti-smudge tracing cloth offered by The Frederick Post Co., Chicago, Ill., is said to permit the making of pencil tracings with the qualities of ink tracings. A 5H pencil can be used to make lines as dense and as dark as a line produced by a 2H or 3H pencil on ordinary tracing cloth. Available in 20-yd. rolls 30, 36, or 42 in. wide, or in various sheet sizes, Penciltex stands up well under erasures.

Other new developments are briefly described in the following paragraphs:

Finish Preserver

Albionite Rapid Cleaner and Surface Sealer are said to provide added protection for car finish. Manufactured by Jones Products, Inc., Cambridge, Mass.

Emulsifying Agent

Dresinate, improved wetting and emulsifying agent, developed for use in conjunction with all types of alkaline metal cleaners, assists aqueous alkaline solutions in certain applications to replace some of the chlorinated solvents. Developed by the Research Department of Hercules Powder Co., Wilmington, Delaware.

Protective Coating

"Glasshield," transparent protective coating for glass, prevents shattering by explosions. Manufactured by Maas & Waldstein Co., Newark, N. J.

Oil-Proof Aprons

New line of heavy-duty, abrasion and tear resistant aprons are immune to all oils and organic solvents. Offered by the Resistoflex Corp., Belleville, N. J.

Fuel Tank Sealer

Especially formulated fuel tank sealer, resistant to the effects of aromatic fuels, can be applied with a brush or a caulking gun. Retains flexibility at -90 F, but will not become soft at temperatures up to 200 F. Presstite Engineering Co., St. Louis, Missouri.

Blackout Alarm

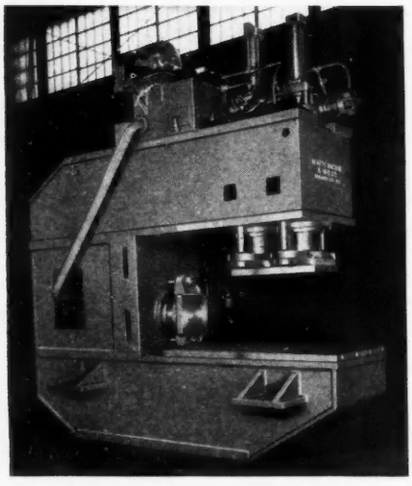
Photoelectric control sounds plant alarm when street lights are turned off. Photoswitch Incorporated, Cambridge, Mass.

Cutter-Retriever

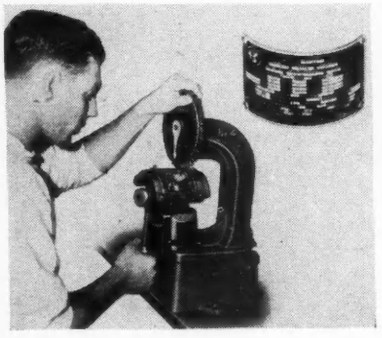
New tool compactly designed to cut wire with one-handed, one-fingered trigger operation, and to retrieve or hold nuts, bolts, washers, etc. Manufactured by Pack-Rite Machine Corp., Milwaukee, Wis.

Drill Press Vise

New design permits operator to drill completely through work without harming vise. Offered by Patterson-Ballagh Corp., Los Angeles, Cal.



Beatty hydraulic forming and flanging press



The new No. 4 Acromarker, manufactured by The Acromark Corp., Elizabeth, N. J., has been designed for the accurate stamping of curved nameplates. Fitted with several means of adjustment, the machine is furnished in either a floor or bench model.

The George Scherr Co., Inc., New York, N. Y., offers this tool stand which was developed to serve as a clamp for holding micrometers, snap gages, and other tools. Equipped with readily adjustable cold rolled steel jaws, the clamp makes it possible to keep body heat from affecting to any appreciable extent the accuracy of the gage in use

Auto Plants Near Peak of Conversion

Engineers Display Ingenuity in Use of "Out-of-Date" Equipment; Many Plants Exceed Production Schedules

Four types of anti-aircraft guns are being made for the Army and Navy, according to the War Production Board. Two of these are adaptations of foreign-designed guns, the Swedish Bofors 40-mm. and the Swiss Oerlikon 20 mm. Other types are the 37-mm. and the 90-mm. The 20-mm. Oerlikon is an automatic cannon with a high rate of fire, used as a defense against dive bombers. It fires a projectile that can tear a hole a foot square in attacking planes. The 37-mm. also is an automatic weapon used primarily by ground troops against low flying aircraft. It fires a projectile weighing approximately a pound and a quarter.

The Bofors 40-mm. also is used against low flying aircraft. It fires a projectile just over an inch and a half in diameter and weighing slightly more than 2 lb. The 90-mm. gun has replaced the 3-in. size as the standard anti-aircraft gun for the Coast Artillery. Usually it is used in batteries of four, controlled by an automatic director. It is used against high-altitude aircraft and fires a projectile weighing about 21 lb.

Various companies in the automotive industry are making all four of these types of anti-aircraft guns, and in case of at least two of them they are in the volume production stage. Eleven plants of the Chrysler Corp. are engaged in manufacturing various parts of the 40-mm. gun, with final assembly in the Chrysler Gun Arsenal. When production began on this weapon the orders were not large and general purpose machinery was used for many of the machining operations. After Pearl Harbor when orders for guns were increased manyfold and the automobile industry was converting all its machinery to war work, a number of huge V-4 type Newton rotary nine-spindle milling machines were installed in the cannon production line. These formerly milled tops and bottoms of cylinder blocks and replaced dozens of the smaller general purpose machines.

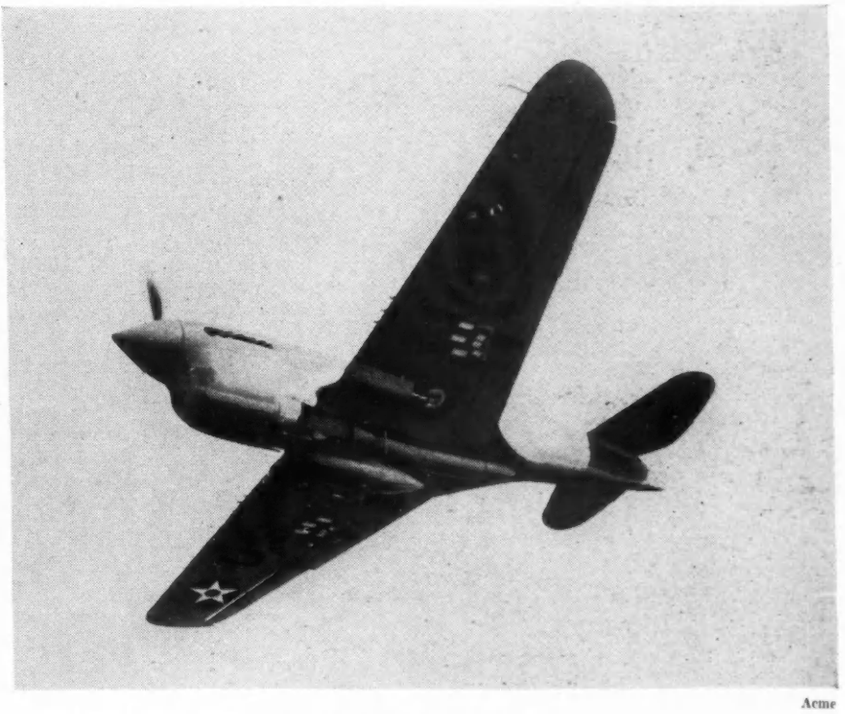
Chrysler machine repairmen have been ingenious in the resurrection of discarded automotive machinery from "graveyards" where it had been relegated by model changes or new manufacturing techniques. Many of these machines have been cleaned and rebuilt and now are turning out armaments for the war program. One particular "graveyard," a former storage shed for derelict machinery, yielded more than 50 machines, despite the fact that the building had burned down and the rusty machines had been considered so worthless that they were left to stand amid the charred ruins.

An ancient gear grinder, idle for 20 years, has been adapted for grinding operations on an aircraft engine. A 30-ton Ingersoll planer-type mill was rebuilt and put to work machining tank parts. It worked so well that the master mechanic recalled a similar machine in a junkyard in St. Louis. He went there and bought that one, which had been shipped to the junkyard from an Oklahoma oil field. Another dis-

(*Please turn to page* 60)

Hold Exhibit Of Aircraft Equipment

A special exhibit of U. S. and Axis aircraft equipment along with a display showing how the automotive industry has converted its production capacity to military aircraft has been arranged for June 8 at Detroit. The exhibit, prepared by the Ford Motor Co., and sponsored by the Engineering Society of Detroit and the SAE, will be held in the Rackham Educational Memorial. Three technical sessions also will be held in conjunction with the display. S. K. Hoffman of the Lycoming Division of Aviation Mfg. Corp. will preside over the morning session at 11 A. M. while R. N. Dubois of Packard Motor Car Co. will be chairman of the afternoon session at 3 P. M. Arthur Nutt of Wright Aeronautical Corp. will be chairman of the evening meeting at 8 P. M., at which T. P. Wright, Assistant Chief of the Aircraft Branch of WPB, will speak on "our War Production Effort in Aircraft."



Acme

Curtiss Warhawk

Newest member of a line of famous fighters, the Curtiss Warhawk, powered by a 1150-hp Rolls Royce Merlin engine is shown during a recent test flight. Designated the P-40F, this ship is a successor to the renowned Tomahawk and Kittyhawk fighters. The Army has not released specific data, but its admission that the plane belongs in the 400-mile-per-hour class and has a fire power superior to the six-gun P-40E induces belief in its greater fighting ability.

Kanzler Foresees Dearth Of Replacement Parts

Material Shortages Curtail Parts Production; Gasoline Rationing Hailed as an Effective Conservation Measure

Ernest C. Kanzler, Chief of the Automotive Branch of WPB, foresees a serious shortage of replacement parts for passenger cars, trucks, and buses within the next 120 days that probably will immobilize many vehicles. Shortages of critical materials, such as chrome for exhaust valves, have prevented manufacturers from even approaching the large quotas that originally were set up for replacement parts production. This has made it impossible to build up the two-year stockpiles that were originally contemplated by WPB. In some cases production lines for replacement parts have been dispersed to war production jobs, thus precluding their use for the duration.

Anticipating difficulty in keeping those cars, trucks, and buses in operation that are essential to the civilian economy, Kanzler wrote to Leon Henderson on March 9, explaining the handicaps involved in making replacement parts due to material shortages. At that time Kanzler stated that either the use of motor vehicles or of replacement parts must be restricted if the nation's civilian transportation system is not to be disrupted.

Kanzler looks upon the rationing of gasoline, as is being done on the Atlantic seaboard and has been proposed for the entire nation, as a practical way of conserving both replacement parts and tires so that they go to the most essential transportation uses. Gasoline rationing is looked upon as a simpler way of conserving the civilian transportation pool by restricting the use of non-essential vehicles, thus cutting the demand for replacement parts and preserving enough such parts to keep the essential vehicles in operation. The Office of Civilian Supply of WPB has estimated that six or seven million vehicles will be immobilized during 1942 for lack of tires or parts.

Rationing gasoline cuts car use and precludes the need for rationing replacement parts, which would entail a multitude of detail and complications in controlling inventories and distribution of such parts. Kanzler said that reports to the Automotive Branch showed that stocks of parts distributors and warehouses were getting low on a number of items and many would have their stocks of certain items exhausted within 90 days.

The material situation with respect

(*Please turn to page* 74)

Acme

Truck Train Hauls High Explosives

Fitted with railroad-type couplers quickly-retractable flanged steel wheels, and regular rubber-tired wheels this truck train can be operated either on rails or on the highway. When driven on rails, the flanged wheels guide the train while the rubber-tired wheels give added traction. The Army has found this type of vehicle to be invaluable in the transportation of high explosives.

Metal Trades Group Holds Annual Meeting

The tremendous expansion that is taking place in the aircraft industry of United States with the production goal for 1942 set at 60,000 warplanes and for 1943 at 125,000 warplanes is indicated by the fact that since the time of the Wright Brothers flight at Kittyhawk in 1903 to the outbreak of World War II on Sept. 3, 1939, only 30,962 planes were produced in this country, J. Carlton Ward, Jr., president of Fairchild Engine & Airplane Corp., told 200 members of the National Metal Trades Association in presenting a factual view of wartime aircraft production during their 44th annual convention on May 19-20 in New York City.

The warplane goals for 1942 and 1943 are not too large, it was pointed out, as the average front line life of a fighting plane is not more than three months and that for an active fighting force of 10,000 fighting planes at the front, something in the order of 100,000 planes in all categories must be manufactured per year if those at the front are to be used in an efficient fashion.

Another measure of the task that lies ahead is the schedule for the aircraft engine factories for 1943 calling for an output of 200-million horsepower, which is reported to be more than that of all the steam locomotives in the United States and enough to drive 2000 modern battleships. Referring to the supply problem of the air force, he stated that they were using 40,000 barrels of high octane gasoline per day the first of this year and by the first of next year they will be burning 100,000 barrels per day.

Various problems pertinent to war production were discussed during the sessions, including the building of employe morale, training for production, employer-employe co-operation, and wage negotiations. At the election Roe S. Clark, of the Package Machinery Co., was named president of the association for the ensuing year, succeeding A. H. Timmerman, of the Wagner Electric Co. H. H. Kerr, of the Boston Gear Works, was elected first vice-president and George A. Seyler, Lunkenheimer Co., second vice-president and treasurer. The following were named councilors for two years:

A. R. Welton, Holtzer-Cabot Electric Co.; Wallace E. Frohock, M. S. Little Mfg. Co.; Floyd Newton, G & O Mfg. Co.; Joseph L. Kopf, Jabez Burns & Sons, Inc.; P. J. Potter, Pangborn Corp.; Edwin B. Hausfeld, Ohio Pattern Wks. & Fdy. Co.; R. W. Gillispie, Jeffrey Mfg. Co.; S. B. Taylor, Reliance Electric & Engineering Co.; Mason B. Jones, S. M. Jones Co.; S. Owen Livingston, Gallmeyer & Livingston Co.; R. G. Wilson, Challenge Machinery Co.; Walter F. Newhouse, Saranac Machine Co.; Howard Goodman, Goodman Mfg. Co.; D. P. Sommer, Keystone Steel & Wire Co.; Ernest Dunford, Landis Machine Co.; John Brown, Chain Belt Co.; A. H. Timmerman, Wagner Electric Corp.

PROMPT DELIVERY IS ONLY ONE WARTIME FEATURE

ON TODAY'S rush production schedules, *ready availability* is an outstanding feature of the Torrington Needle Bearing. Thanks to a program of steady expansion, Needle Bearings can be delivered promptly in standard sizes and types *on all priority orders.*

But the features that first won industry-recognition for the Needle Bearing are now important wartime advantages, too. See if you don't agree that each one fills an immediate need, simplifying your product design and speeding production.

YOU SAVE TIME installing the Needle Bearing. It is built as a single compact unit. One quick operation presses it into place in the housing. Here is modern design for today's high speed production line methods.

YOU CONSERVE VITAL MATERIALS. The Needle Bearing's small outside diameter represents a material saving in itself. And this in turn enables you to reduce the size of surrounding members, conserving still more materials for needed use elsewhere.

YOU ELIMINATE EXTRA PARTS and assembly steps. The Needle Bearing stays in place without the aid of retaining rings, washers or end plates. And efficient lubrication eliminates the need for all but occasional renewal of lubricant. Both of which again save vital materials.

YOU IMPROVE PRODUCT PERFORMANCE. The Needle Bearing's high load capacity, low power consumption and long life make improvements possible in your product design and operation, reducing manufacturing costs.

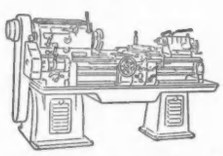
These advantages of the Needle Bearing—proven conclusively in thousands of applications—can help you guard against production delays that are more costly now than ever. Find out from a Torrington engineer how easily this unique bearing, available for prompt shipment on priority orders, can be adapted to your wartime designs. Complete details are available in Catalog No. 107. Write, wire or phone for your copy today.

THE TORRINGTON COMPANY
TORRINGTON, CONN., U. S. A. • *Est. 1866*
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
Cleveland Seattle Chicago Los Angeles
San Francisco Toronto London, England

LET'S GO! U.S.A. · KEEP 'EM FLYING

TORRINGTON NEEDLE BEARING

LOW MAINTENANCE COST



Used in the feed boxes of 12-inch to 18-inch heavy-duty and 17-inch to 24-inch Regal lathes manufactured by The R. K. LeBlond Machine Tool Co., Needle Bearings reduce the need for maintenance attention, because of their simple, effective system of lubrication and their long life.

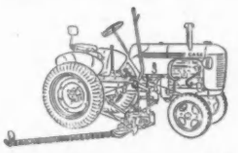
R. K. LEBLOND

HIGH-SPEED OPERATION

35 Torrington Needle Bearings are used in construction of 600 ampere, 1,500,000 Kva outdoor type oil circuit breakers built by Allis-Chalmers Manufacturing Company. Located at key points in mechanism, the Needle Bearings aid in maintaining high-speed operation.

ALLIS-CHALMERS

INCREASED EFFICIENCY



Needle Bearings on power lift shafts and in universal joints on propeller shafts increase operating efficiency and conserve power in the No. 14 Case-Detroit Highway Mower. In addition, the Needle Bearings provide high load capacity for both oscillating and rotating service.

CASE-DETROIT

Unions Up Efforts to Organize Aircraft Plants

Aiming for Organization of West Coast Plants, UAW-CIO Boasts of Over 110,000 New Members, Much Higher Wages

One of the major objectives by the UAW-CIO at its annual convention last summer was the organization of the aircraft industry. This drive was put in the hands of Richard T. Frankensteen, formerly director of the Chrysler Division of the union. The UAW-CIO now claims more than 110,000 new members in the aircraft industry as a result of more than 30 new contracts, and an increase in the average wage in the aircraft industry from 70.2 cents to 91.6 cents per hour.

Current aims of the UAW-CIO organizers are the huge plants of the Douglas Aircraft Co., Inc., at Long Beach and Santa Monica, Cal., and six plans of the Curtiss-Wright Corp. at Paterson, N. J., Caldwell, N. J., and Buffalo. Assisting in the Douglas drive is William B. Taylor, who played a prominent part in the organizing drive at the Ford Rouge plant last year. The UAW-CIO already holds contracts at North American Aviation, Inc., Vultee Aircraft Corp., and Ryan Aeronautical Corp. in Southern California. The North American local is the largest CIO local on the West Coast.

The International Association of Machinists (AFL) holds bargaining rights at the Lockheed Aircraft Corp., Vega Airplane Co., and Consolidated Aircraft Corp. Lockheed-Vega granted wage raises of 10 cents an hour, totaling $25 million on an annual basis, last November. Consolidated signed a contract with the machinists' union last October calling for a general 13-cent raise. Secondary to Douglas as a West Coast objective for the UAW-CIO is Northrop Aircraft, Inc., at Hawthorne, Cal. Other plants which the UAW-CIO looks forward to bringing within the union fold are the North American plants at Dallas and Kansas City, the Consolidated plant at Fort Worth, Tex., the new Douglas-operated plant at Tulsa, Okla., and several plants in Wichita, Kan. The new Buick aircraft engine plant at Melrose Park, Ill., also is on the UAW-CIO schedule.

The UAW-CIO scored its first success against the Curtiss-Wright Corp. when it won an NLRB election at the Port Columbus, Ohio, plant by gaining 58 per cent of the 2655 votes cast. Twenty-seven per cent of the workers voted for no union and 14 per cent for the International Association of Machinists (AFL). Elections are scheduled at five New Jersey plants of the Wright Aeronautical Corp., a Curtiss-Wright subsidiary, with the UAW-CIO contesting for the vote with the Wright Aeronautical Employes' Association, an independent union. Another NLRB election has been set for June 24 at Curtiss-Wright's Buffalo plant, where the P-40 planes are manufactured. Contesting in this election will be the UAW-CIO and the AFL machinists' union. The NLRB refused a petition of The Aircraft, an unaffiliated union,

(*Please turn to page* 64)

Cut Quota of Tires For June Rationing

A quota of tires for rationing in June lower than the quota for May has been announced by OPA. Planned as another step to conserve rubber, this decrease is contrary to the seasonal pattern of replacement sales in previous years.

Passenger vehicle tire quotas for June show a reduction in the number of new and recapped tires and inner tubes as compared with May. For trucks, there is a moderate increase in the number of new tires made available, but this is more than offset by a cut in the recapped tire quota as compared with May.

In making the cut in the recapping rather than in the new tire quota for trucks, OPA took into consideration the approaching season of hot weather. The truck quota, which provides for buses, trucks, industrial tractors, and farm equipment, includes 247,715 tires, 365,-014 recaps, and 309,116 inner tubes. The quota is a little less than 1 per cent below the May quota.

The June quota also makes available 49,584 new tires for List A passenger vehicles, 479,051 recapped tires or recapping services for List A and List B together, and 265,007 inner tubes. The total of new and recapped tires for June is 16.5 per cent less than the total for May.

Import Kok-Sagyz Seeds

Kok-sagyz seeds, from which the Russian rubber-producing dandelion is grown, are being shipped to this country, according to William O'Neil, president of General Tire and Rubber Co. The first seeds are being sent by airplane so that tests may be conducted during the 1942 growing season.

Ford-Built Military Vehicles

Reading from left to right, the Ford military vehicles included in the picture are: a cargo truck, an observation post tender, a weapon carrier, a motor gun carrier, and a ¼-ton Army reconnaissance car, the tough and highly touted Jeep.

FOR A WAGON LOAD OF RIFLES

In 1861 a wagonload of rifles was a major contribution to national defense. In 1941 it might help some, but it wouldn't help enough.

Yet on the vast scale in which the fate of the world is being weighed today, one of the heaviest contributions to the survival of freedom is an intangible contribution, and it comes from the same original sources as Hilliard's wagonload of small arms.

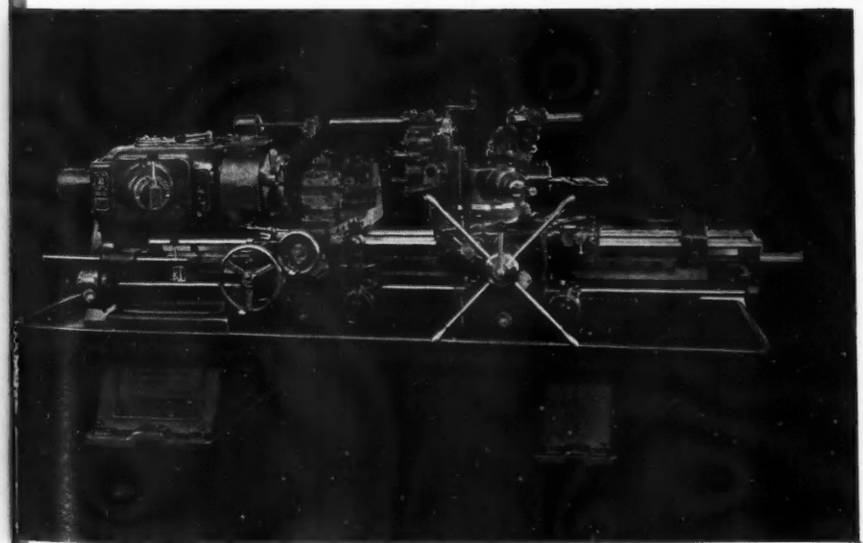
This contribution consists of the skill, experience and adaptability of a machine tool engineering and precision manufacturing organization whose continuous development began with Hilliard's predecessors over a century ago. Continued in turn by men like Hubbard, Kendall, Robbins, Lawrence, Howe and Hartness, this unbroken progress makes Jones & Lamson machine tool technique available to you in its present high speed, modern form.

With Jones & Lamson equipment you can speed wartime production now, and with it later you will be in position to earn a living profit in the hard years ahead.

That's why it pays to put production problems up to Jones & Lamson engineers. That's why it is so advantageous to be Jones & Lamson equipped. Illustrated catalogs of this equipment are available, and inquiries from large plants or small receive careful study here.

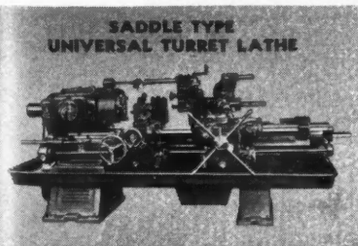
JONES & LAMSON

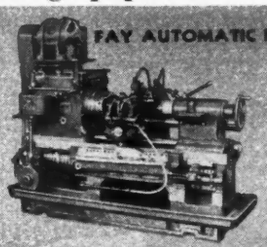
MACHINE COMPANY, Springfield, Vermont, U. S. A.

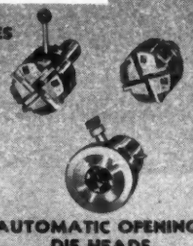


7A Jones & Lamson Saddle Type Universal Turret Lathe with standard chucking equipment.

Manufacturers of Ram & Saddle Type Universal Turret Lathes . . . Fay Automatic Lathes . . . Automatic Thread Grinding Machines . . . Comparators . . . Automatic Opening Threading Dies and Chasers







J&L

PROFIT PRODUCING
MACHINE TOOLS

Chrysler-Built Fire Truck

Only a short time ago the Chrysler Corp. announced the production of a small fire pump mounted on a trailer which could be easily attached to a touring car. Now the same unit appears as part of a complete fire truck. The standard pump unit, mounted behind the cab, is driven by a 95-hp Dodge truck engine, and delivers 500 gpm at 120 psi; an alternate setting gives a delivery of 250 gpm at 200 psi. In addition to many accessories, the truck carries two sections of suction hose and 500 ft. of 2½-in. standard fire hose. Built-in skids facilitate removal of the pump for installation on the original Chrysler-built passenger-car trailer.

TEAMWORK
Will turn it out FASTER
How to step up output is every American's problem today. For the more we do, the sooner we win. That is why teamwork is so important.
Why not let Kerns specialists team up with you to speed production as they have with scores of leading manufacturing plants by developing the lubricant or compound that fits your job exactly. Kerns products include the following:
HOT DIE COMPOUNDS FOR FORGINGS
REDUCE STICKING AND SCORING.
CUTTING COMPOUNDS FOR FERROUS AND NON-FERROUS METALS
INCREASE TOOL LIFE AND SPEED PRODUCTION
DRAWING COMPOUNDS FOR STEEL, ALUMINUM OR BRASS
SAVE DIES, REDUCE REJECTIONS AND DISCOLORATION
We are eager to demonstrate a Kerns Compound on your toughest job. Write or phone for a production test sample. There is no obligation.
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Amend Tire Rationing Regulations

As a step in rubber conservation, Price Administrator Leon Henderson has announced an amendment to the tire rationing regulations which will permit bus transportation companies to enter into new tire and tube leasing contracts with tire manufacturers or wholesalers.

Heretofore, under the regulations, new lease contracts were not permitted, although those that were in effect during 1941 could be continued or renewed. In addition to providing for new contracts, the revision in the regulations will make it possible for bus companies to switch from one supplier to another, which will permit a renewal of competition among rubber companies for the business.

The necessary changes to open the way to new contracts are contained in Amendment No. 10 to the Revised Tire Rationing Regulations.

T. E. Moss Wheat

T. E. Moss Wheat, 50, dean of the Chrysler Graduate School of Engineering, died suddenly May 7 at his home in Detroit. He had been with Chrysler Corp. for the past 10 years.

CALENDAR

Conventions and Meetings

American Society of Mechanical Engineers, Semi-Annual Meeting, Cleveland, Ohio ..... June 8-10
Industrial Salvage Conference, New York ..... June 17
Natl. Aeronautic Assoc., Annual Mtg., New York City ..... June 19-20
Eastern Photoelasticity Conference, Boston ..... June 20
Automotive Engine Rebuilders Assoc., Cleveland, Ohio ..... June 22-24
American Society for Testing Materials, Atlantic City, Annual Mtg. .... June 22-26
National Petroleum Association, Atlantic City, Annual Mtg. ..... Sept. 16-18
Natl. Metal Congress & Exposition, Cleveland ..... Oct. 12-16
American Welding Society, Detroit, Annual Mtg. ..... Oct. 12

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Narrow fluctuations of general business activity continue. The index of *The Journal of Commerce*, without adjustment for seasonal variation, for the week ended May 16 stands provisionally at 120.8 per cent of the 1927-29 average, as compared with 119.7 for the preceding week. The adjusted index of *The New York Times* for the week ended May 9 was 132.4 per cent of the estimated normal, as against 133.1 a week earlier and 126.2 a year ago.

Department store sales during the week ended May 16, as reported by the Federal Reserve Board, were 5 per cent above those a year ago. For the four weeks then ended, the similar gain was 8 per cent, with total sales in 1942 to that date 19 per cent greater than the comparable value last year.

Railway freight loadings in the week ended May 16 totaled 839,052 cars, 201 fewer than the number for the preceding week and 21,750 below the figure a year ago.

Electric power output declined contra-seasonally in the same period and was 11.5 per cent above that a year ago, as against a corresponding gain of 12.0 per cent recorded for the week before.

Crude oil production during the week ended May 16 averaged 3,483,900 barrels daily, 60,450 barrels below the figure for the preceding week but 9,400 barrels greater than the average output recommended by the Office of the Petroleum Coördinator.

Average daily production of bituminous coal in the week ended May 9 was 1,900,000 tons, as compared with 1,883,000 tons for the week before and 1,517,000 tons a year ago.

Business failures in the second week of May numbered 215, according to the Dun & Bradstreet report, as compared with 216 a week earlier and 286 a year ago.

Professor Fisher's index of wholesale commodity prices for the week ended May 15 was unchanged at 106.3 per cent of the 1926 average, as against 83.4 a year ago.

Member bank reserves dropped $181 million during the week ended May 20, and estimated excess reserves declined $360 million to a total of $2570 million. Business loans of reporting members increased $20 million in the preceding week and stood $1065 million above the total a year ago.

PUBLICATIONS

Details of Design of Shafts and Housings for Ball Bearings is the title of the first of a series of booklets issued by New Departure. It includes proportions and finish of bearing seats; locknut threads; recommended shaft shoulders; designing to aid disassembly; locating and clamping methods; and the use of adapter sleeves.*

A new bulletin describing the **Fleet-Fillet** welding technique for speeding war production has been published by Lincoln Electric Co.*

The Bristol Co. has just published a folder, P-1102, describing its newly developed line of **Pyrovac Radiation Pyrometers.** The folder includes engineering drawings showing methods of use.*

The B. F. Goodrich Co. has just issued Catalog Section 2800, on **Care and Maintenance of Conveyor and Elevator Belting,** a guide to economical material handling with rubber belts.*

In the interest of rubber conservation, two **wall cards on care of rubber hose** have been prepared by The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc. One card is devoted to the care of fire hose and the other gives rules for the proper care of air, water, steam, and other type of rubber hose and for attaching of couplings.*

Four new catalogs by George Gorton Machine Co. are as follows: No. 1400-A on Gorton **Super-Speed Vertical Milling Machines; Die and Mold Duplicators,** for production profiling and duplicating; No. 1580-A **Pantograph Engraving Machines,** giving descriptions, specifications and illustrations of the complete Gorton Pantograph line; and No. 1309-A Gorton **Master Copy Type for All Pantograph Machines.***

Bendix Products Division, Bendix Aviation Corp. has isssued a booklet **A B C of Vacuum Power Brakes,** designed principally for the basic training of students and apprentices in the fundamentals of automotive vacuum power braking as exemplified in Bendix B-K products.*

B. M. Root Co.'s catalog No. 120 describes and illustrates its **electric hydraulic boring machines.***

DeWalt Products Corp. has issued two new circulars on the DeWalt **Heavy-Duty metal cut-off machine** for cutting gates and risers from bronze and aluminum castings.*

A new diesel-electric locomotive designed specifically for use in industrial

(*Please turn to page* 58)

BUY

DEFENSE BONDS AND STAMPS

. . . AND LONGER LASTING AETNA BALL BEARINGS

☆ Remember the wiser you buy the more you help to conserve labor and materials that are indispensable to a nation at war—to *VICTORY!*

Long-lived, dependable AETNA PRODUCTS mean less frequent replacements, increased production and extended machine life. You save for yourself, for your country.

AETNA BALL BEARING MFG. CO.

4600 Schubert Ave., Chicago

Thrust Ball Bearings (Standard and Special) . . . Angular Contact Ball Bearings . . . Roller Bearings (Special) . . . Ball Retainers . . . Hardened and Ground Washers

Publications

(*Continued from page 57*)

plants is described in Catalog 3756, General Electric Co.*

A new **lighting manual** has been announced by the Benjamin Electric Mfg. Co. The main section of the manual is devoted to the solutions for the 21 lighting problems most commonly encountered in plants converting to war production.*

A new folder on **An-cor-lox Lock Nuts** has just been issued by An-cor-lox Division, Laminated Shim Co.*

General Controls Co. has issued a new bulletin on its line of **portable electric magnetic valves** which resist vibration and change of motion as well as operate in any position.*

Micromax Speed Recorders are described in a new 12-page catalog by Leeds and Northrup Co.*

A four-page bulletin on **hydraulic jacks** has been issued by The Watson-Stillman Co. Independent-pump jacks, vertical outside-pump jacks, and horizontal outside-pump jacks are illustrated and described. Complete specifications tables are also given for all three types.*

United Chromium, Inc., has issued a 16-page data bulletin summarizing the applications where industrial chromium plating can save materials and man-hours in the production and maintenance of metal products.*

* Obtainable through editorial department, AUTOMOTIVE AND AVIATION INDUSTRIES. Address: Chestnut and 56th Streets, Philadelphia, Pa. Please give date of issue in which literature was listed.

Speed up Assembling with HOLTITE Fastenings

Above: There's a HOLTITE fastening for every purpose. Regular or Special, these rugged, accurate, uniform fastenings provide the solution to assembly problems. Specify HOLTITE on your next order.

Left: HOLTITE-Phillips recessed head screws and bolts speed production by cutting fastening time up to 50%. These modern units can be driven by all types of power drivers on work previously requiring hand operation.

CONTINENTAL SCREW CO. New Bedford, Mass., U.S.A. Warehouse at Detroit Mich.

MEN . . . . . .

Marvin E. Coyle, vice-president of General Motors Corp. and general manager of the Chevrolet Motor Division, will be awarded the honorary degree of doctor of engineering, June 3, at the annual commencement exercises of the University of Detroit. He also will deliver the commencement address. **Frederick S. Searle,** superintendent of the Ford Motor Co. industrial schools, will be awarded the degree of doctor of science in education.

Dr. Charles F. Phillips, formerly associate professor of economics at Colgate University has been appointed chief of the tire rationing branch of OPA. He has been with OPA since December. He succeeds **Grenville R. Holden,** who had been called in to act as special assistant to Leon Henderson during the formation of the tire rationing division.

Edgerly W. Austin, sales engineer of the Timken Roller Bearing Co., has been elected chairman of the Detroit Section, SAE, for the year beginning June 1. He succeeds Tore Franzen, of Chrysler Corp. **Albert C. Hazard,** of the Chevrolet Motor Division, was elected secretary and **F. W. Marschner,** of the New Departure Division of General Motors, treasurer. Vice chairmen elected were **Max M. Roesch,** Chrysler Corp., passenger car; **R. J. Waterbury,** Chevrolet passenger car-body; **C. R. Alden,** Ex-Cell-O Corp., production; **R. C. Gazley,** Murray Corp. of America, aeronautic, and **R. B. Sneed,** Ethyl Gasoline Corp., junior student.

A. J. Valley, formerly service engineer, has been promoted to engineering service manager of Adel Precision Products Corp.

Robert M. Zacharias, formerly of Church & Church, patent attorneys of Washington, D. C., has become associated with the McKenna Metals Co.

Henry M. Hogan, assistant general counsel of GM Corp., has been elected board chairman of North American Aviation, Inc. He succeeds Ernest R. Breech, who resigned the chairmanship when he became president of Bendix Aviation Corp.

Edward Noe, formerly of the patent law firm Marechal & Noe, has been made secretary of The Sheffield Corp. **John P. Bernard,** vice-president and general manager, has been appointed a director of the Corporation.

Frank H. Dewey has been elected a vice-president of Gar Wood Industries, Inc. He will continue his duties as general manager of the Air Conditioning Division.

William L. Wilson has been named director of the newly organized Department of Industrial Relations of Republic Aviation Corp. **Thomas W. MacDonald** fills the post of public relations director formerly held by Mr. Wilson.

Walter O. Briggs, Jr., treasurer of Briggs Mfg. Co., has joined the Army Air Corps as a second lieutenant, reporting for duty at Wright Field.

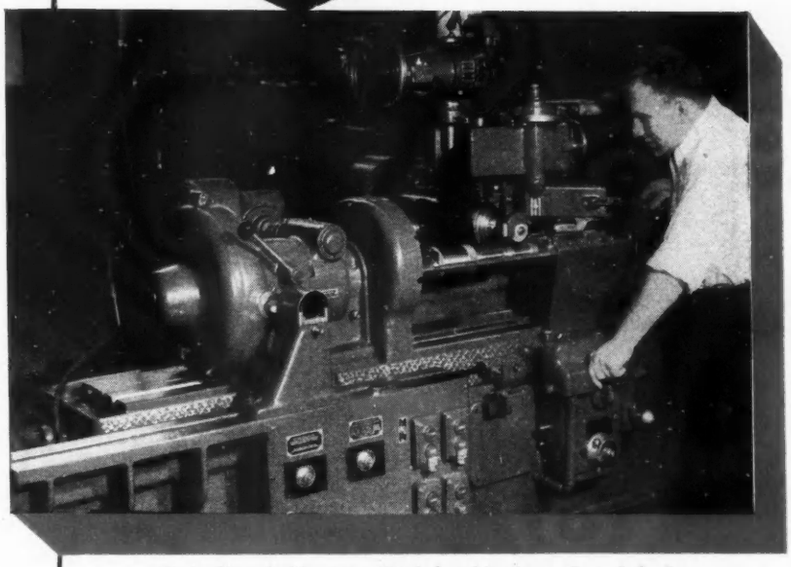
Walter Geist, formerly executive vice-president, has been elected president of Allis Chalmers Mfg. Co. He succeeds **W. C. Buchanan,** who resigned because of ill health. **William Watson,** vice-president in charge of manufacturing, has retired after 41 years' service with the company. His successor is **James M. White,** formerly general works manager.

Gail E. Spain, formerly general sales manager, has been appointed vice-president of Caterpillar Tractor Co. **John Q. McDonald** will succeed him as general sales manager. **J. D. Fletcher,** vice-president, will take over active direction of export sales.

William J. O'Neil, president of the Dodge Division of Chrysler Corp., has been appointed general manager of the new Chrysler airplane engine plant at Chicago that will be operated by the Dodge Division. **Lester L. Colbert,** Chrysler resident attorney at Detroit, has been named operating manager of the new plant. **E. H. Priebe,** formerly works manager of the Chrysler-Jefferson plant, has been named assistant general works manager for the Chrysler-Jefferson and Chrysler-Kercheval plants.

(*Please turn to page 80*)

GRINDING for PERFECTION of FINISH and DIMENSIONAL ACCURACY



Grinding Splines on Wright Airplane Crankshafts

with FITCHBURG *Automatic Closed Cycle Grinding*

Continental Motors of Detroit have installed Fitchburg Spline Grinders for grinding splines on airplane crankshafts. These new Fitchburg Automatic closed cycle machines are the culmination of more than 30 years of precision grinding machine development.

No longer is there need to put up with excessive cost of spline grinding by outmoded methods. Fitchburg technique will save on assembly time — divide torque pressure more evenly and produce finishes that will give more even wear on sliding splines at high speed.

The result of using the Fitchburg method is lower costs, higher degree of accuracy, higher speed in operation, and smoother product performance.

New operators can rapidly be trained to produce accurate splines at high speed.

It will not obligate you to mail in your blue prints for study. Write today for catalog showing wide range of other successful applications.

FITCHBURG GRINDING MACHINE CORP.
FITCHBURG, MASSACHUSETTS, U.S.A.

Manufacturers of — Bowgage Wheelhead Units, Multiple Precision Grinding Units, Spline Grinders, Cylindrical Grinders, Gear Grinders, Bath Full Universal Grinders and Special Purpose Grinders.

Plant Conversion

(*Continued from page* 47)

carded mill was located in Chicago and all are now busily engaged in Chrysler's expanding program of tank production. Chrysler machinists also located 44 old gear cutting machines that have been changed over for a spline job on a universal joint.

Another automotive company, producing aircraft cannon in large quantities, delivered its first gun to the Army last October by filling in with available machinery. The first delivery would not have been until April if the company had waited for new machinery to be received for certain operations. Only seven of the 172 machines on the pilot gun line were converted automotive machines but without them there would have been a six-month delay in actual production. When orders were boosted after Pearl Harbor and passenger car output neared its close, 63 additional machines from automobile departments were rebuilt for gun manufacture in December and January and 33 more such machines were converted in February.

This same company also is producing forgings for airplane landing gears. There are 14 different types of landing gears for as many models of aircraft and each type requires 12 different forgings. This means 168 types of forgings, each with its own particular set of dies. These forgings range in size from 58 to 425 lb.

The automotive industry appears to be doing a good job on deliveries of airframe subassemblies for Army bombers and other aircraft. W. P. Brown, president, recently reported that Briggs Mfg. Co. was 39 per cent ahead of required schedule on one major wing assembly order at the end of April, 38 per cent ahead on another wing section job, and 13 per cent ahead on deliveries of another complete wing contract. More than 80 per cent of Briggs' presses, most of which were used in the manufacture of automobile bodies, are being used on war work or allocated to such work on contracts not yet in production. Brown cited the fact that 1942 model automobile bodies were composed of 1100 individual pieces, while on aircraft jobs there are more than 8000 individual pieces.

Maj.-Gen. A. D. Surles, Army information chief, recently announced officially that the Ford bomber plant at Willow Run is "in production." He confirmed the fact that the first "pilot model," taken apart and assembled a number of times by crews of workers to train them in assembly lines operations, is ready for ground tests and that experimental operations on the assembly line have been completed. The manufacture of the huge four-engined B-24 bombers has been broken down into 70 subassemblies.

"Today we have a block of bombers on the assembly lines," C. E. Sorensen, Ford vice-president, recently told a group of visiting newsmen.

The Ford-built bombers will be powered by four Pratt & Whitney engines built by the Buick Motor Division of General Motors at a new plant in Illinois. Buick is a year ahead of schedule on these engines, which have passed the required Army tests.

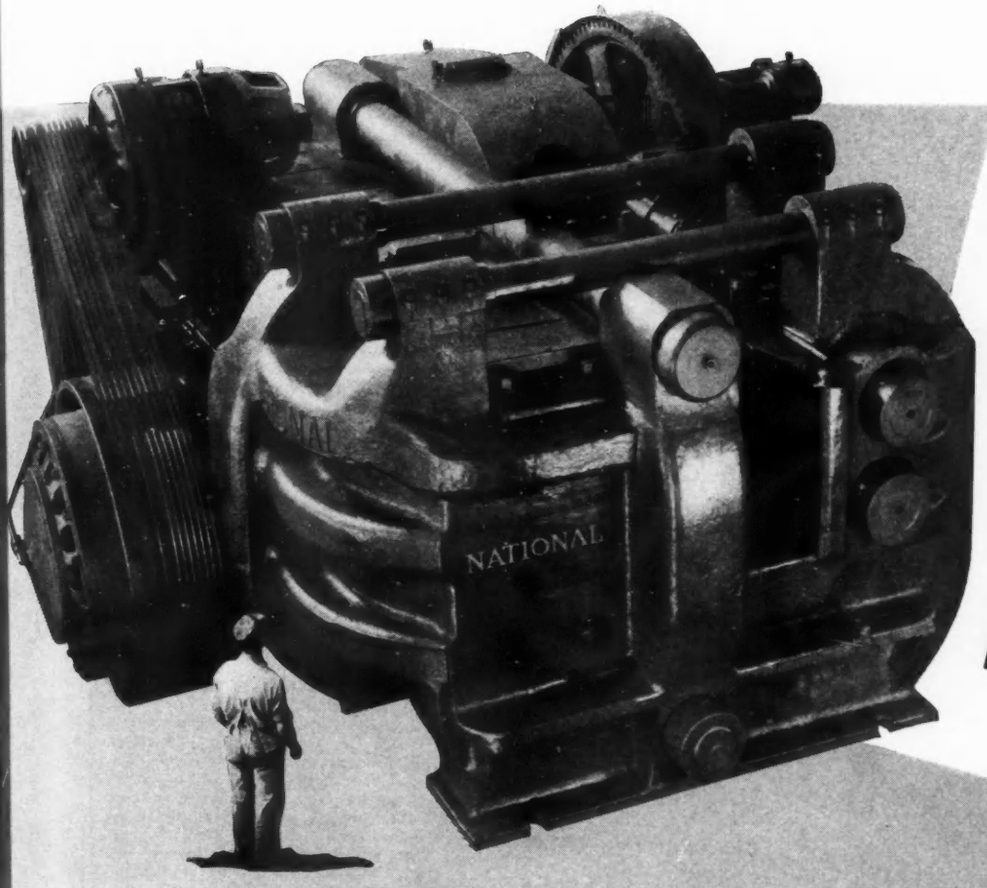
Among other automobile manufacturers making airplane fuselages, Hudson made its first delivery of the rear fuselage section for a medium bomber 11 months after the letter of intent was received from the Government and this first section passed all inspection tests. Chrysler, making the nose and center fuselage sections for the same plane, did not receive final blueprints until January after all the design changes had been made but the first sections have now come off the assembly lines of the DeSoto Division. These sections contain 15,000 parts.

Another Ford war project besides bombers is nearing the volume production stage. Production of M-4 tanks in some quantity is expected from the Highland Park plant before July 1. Ford will make the complete tank, with the exception of two pieces of equipment, and much of the parts produc-

(*Please turn to page* 62)

45 Billion
GEAR TOOTH CONTACTS
(500,000 PER MINUTE)
.. without measurable wear
A prominent manufacturer added "dag" colloidal graphite to his grease for a test involving 1500 hours of running time and 500,000 gear tooth contacts per minute. No measurable wear was detected . . . Subsequent performance of the test grease without "Oildag" (colloidal graphite in oil) was unsatisfactory . . . Send for comprehensive report by their test engineer and bulletin No. 220C
ACHESON COLLOIDS CORPORATION
PORT HURON, MICHIGAN
"Dag" and "Oildag" are registered trade-marks of A. C. C.
dag
COLLOIDAL PRODUCTS
The electric-furnace graphite used in "dag" products is made in U. S. A.

STEEL CASTINGS



make BETTER forgings possible

Sounds a little inconsistent, doesn't it? For in some applications, forgings and castings are pretty active competitors.

Still the frame of this giant forging machine, designed for producing airplane cylinders, is made of steel castings —for rigidity, for precise accuracy and for economy. The machine is the largest of its kind ever built and weighs over 500,000 pounds.

This is typical of the thousands of jobs steel castings are doing to advance our war production effort—to deliver vastly increased numbers of guns and tanks and ships and planes.

When it comes to building things better and quicker and at less cost, engineers and designers are inclined to look into steel castings FIRST. They require less time to prepare for production. They make available all the desirable properties of steel—strength, hardness, rigidity, resistance to fatigue and stresses and resistance to extremes of heat, cold and pressure.

They often introduce new economies by combining many parts in a single casting—saving finishing and assembly time. They reduce the handling and machining off of needless metal, and make it easy to get weight and strength exactly where they are needed most.

May we suggest that you discuss both old and new production problems with your steel foundryman. Or you may communicate—no obligation of course—with Steel Founders' Society, 920 Midland Building, Cleveland.

MODERNIZE AND IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS

Plant Conversion

(*Continued from page 60*)

tion will be at the Rouge plant. It will be powered by an eight-cylinder adaptation of the Ford V-12 liquid-cooled aircraft engine developed by Ford engineers.

Latest report of the Automotive Council for War Production's machine tool and equipment service reveals that approximately 66 per cent of the industry's machines are now operating on war work and an additional 3 per cent have been earmarked for such production. Nearly 198,000 pieces of equipment have been listed with the Council service by 249 companies operating 427 plants. These figures exclude one motor vehicle manufacturer, 45 parts and equipment firms and 44 tool and die establishments which have advised the Council they have no idle facilities. The ACWP staff has completed classification of 150,000 of the machines listed. Besides the 69 per cent operating or slated for war work, 9 per cent are producing automotive replacement parts under government authorization, 13 per cent are available for transfer to other manufacturers for war work and war work is being sought for the remaining 9 per cent.

• • • *Unequalled* SURFACE SMOOTHNESS and SPHERICITY

The series of lapping operations performed as a matter of course in the Strom plant give Strom Steel Balls a degree of surface smoothness and sphericity that has always been unequalled in any other regular grade of ball. Only through such unique lapping practice can extreme precision be obtained.

Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Strom Balls.

Other types of balls—*stainless steel, monel, brass* and *bronze* — are also available in all standard sizes. Write for catalog and prices.

Strom STEEL BALL CO.
1850 So. 54th Avenue, Cicero, Ill.
The largest independent and exclusive Metal Ball Manufacturer

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE AND AVIATION INDUSTRIES, M. W. Bourdon.

The Government hopes to receive soon the report of a committee appointed many months ago to investigate the scope of producer gas as a fuel for road vehicles and the extent to which gas traction could be adopted in view of the lack of a surplus in coal supplies. The committee has also been testing new types of producer equipments in commercial services and will include the results in its report.

* * *

In attributing the increase of road accidents to the black-out, as area coroner said recently that he could see no good reason for a nightly black-out or the excessive restriction of vehicle lighting. It would be sufficient, he considered, to enforce these precautionary measures during the periods covering threatened and actual air raids. He added that his experience had shown that in very few cases were drivers of cars to blame for road accidents during the black-out.

* * *

During a debate in Parliament a member alleged that the slow development of the reclaiming, retreading and synthetic rubber industries in Britain was largely due to the pre-war opposition of new tire manufacturers who, for example, had done all they could to prevent an independent reclaiming company from getting the requisite equipment and had made attempts in their own interests to falsify reports of Army tests of retreaded tires. Prior to these allegations being emphatically denied by a Government speaker, another member, himself the chairman of one of the largest reclaiming companies in the country, said that the allegations were without foundation and that actually the new tire makers had been among the largest buyers of reclaimed rubber and had done all they could to persuade the public to have their serviceable tires retreaded. This member did, however, criticise the Government for permitting merchants to act as intermediaries between the dealer-collectors of scrap rubber and the reclaimers and so take a go-between profit that increased the price of scrap to the reclaimer by over 30 per cent.

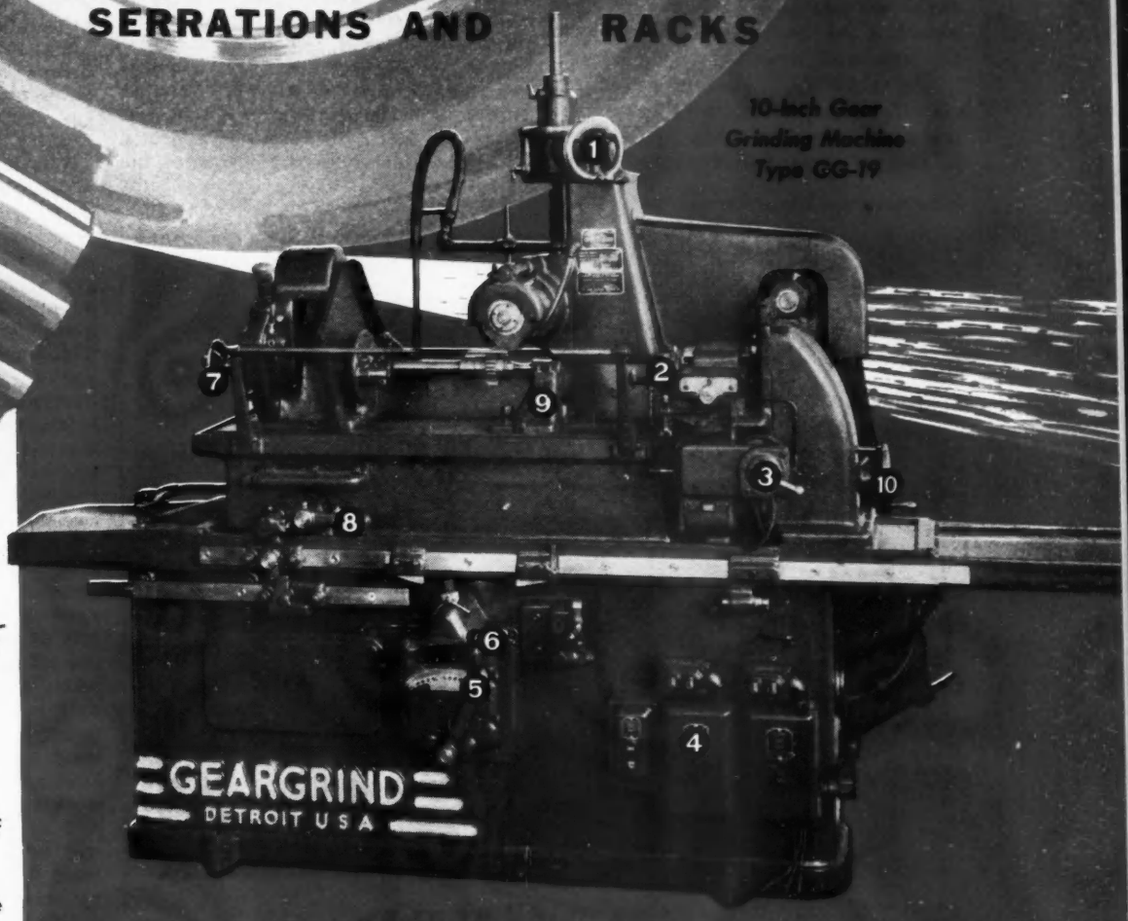
In the course of the debate mentioned above it was stated officially that only 4 per cent of the new tire production by British manufacturers had been absorbed during the war by the owners of private passenger cars, a large proportion of which were used for essential transport. The remaining 96 per cent, it was said, was produced on Government account, either directly or indirectly.

Cadillac Achieves Perfect Bond Sale Record

Cadillac Motor Car Division of General Motors became one of the first large automotive companies to attain a perfect record when it was announced by Nicholas Dreystadt, general manager, that 100 per cent of the employes had subscribed for the purchase of war bonds. This included the plant at Detroit, which is producing war materials, and retail branches at Detroit, New York, and Chicago.

GEARGRIND MACHINES

FOR FORMED WHEEL GRINDING OF HARDENED GEARS, SPLINES, SERRATIONS AND RACKS



10-Inch Gear Grinding Machine Type GG-19

Simplicity

All Controls Directly Before the Operator

1. Grinding wheel feed control.
2. Device for trueing periphery of wheel.
3. Hydraulically controlled valve for diamond trueing of side of wheel.
4. Electric switches for spindle drive, hydraulic drive and coolant pump motors.
5. Speed control lever.
6. Reverse lever.
7. Receding center hand wheel control.
8. Hand index lever.
9. Adjustable tail stock.
10. Elevating hand wheel for trueing device.

BETTER GEARS — faster! Gears and racks with accurate tooth profiles — splines and serrations with full-bearing key surfaces.

No need to worry about getting special, non-deforming steels. No specialized heat treatments.

All GEARGRIND Machines are semi-automatic, using a low-pressure hydraulic system that gives exceptionally smooth performance — speed plus accuracy.

CONTRACT GRINDING You are invited to discuss special grinding problems, either with reference to grinding in your own plant, or having our Contract Grinding Division grind external, internal and helical gears, racks, splines and serrations on contract. Prompt attention to all requests for information.

The GEAR GRINDING MACHINE COMPANY

DETROIT MICH U S A

Unions Organize Aircraft Plants

(*Continued from page* 50)

to be represented in the poll, upholding a charge of the UAW-CIO that it is company-dominated. Curtiss-Wright signed a contract with The Aircraft last December granting pay increases.

The UAW-CIO also increased its eastern aircraft membership in the last few months by capturing 57 per cent of the votes at the Vought-Sikorsky plant in Stratford, Conn. Five months previously the UAW-CIO had received only 34 per cent of the votes in losing out to "no union," which polled 200 more votes. The UAW-CIO doubled its vote in the five months, capturing most of its strength from the competing AFL machinists' union, which lost more than 600 votes. The UAW organizing drive at Vought-Sikorsky included radio programs, a special union newspaper, direct mail, and a big rally.

The UAW-CIO recently renewed contracts at the Bell Aircraft Corp. in Buffalo and the Brewster Aeronautical Corp. An NLRB election is expected to settle a jurisdictional dispute at the Fairchild Aviation Co. One of the union's biggest goals is the Glenn L. Martin Co. plant at Baltimore.

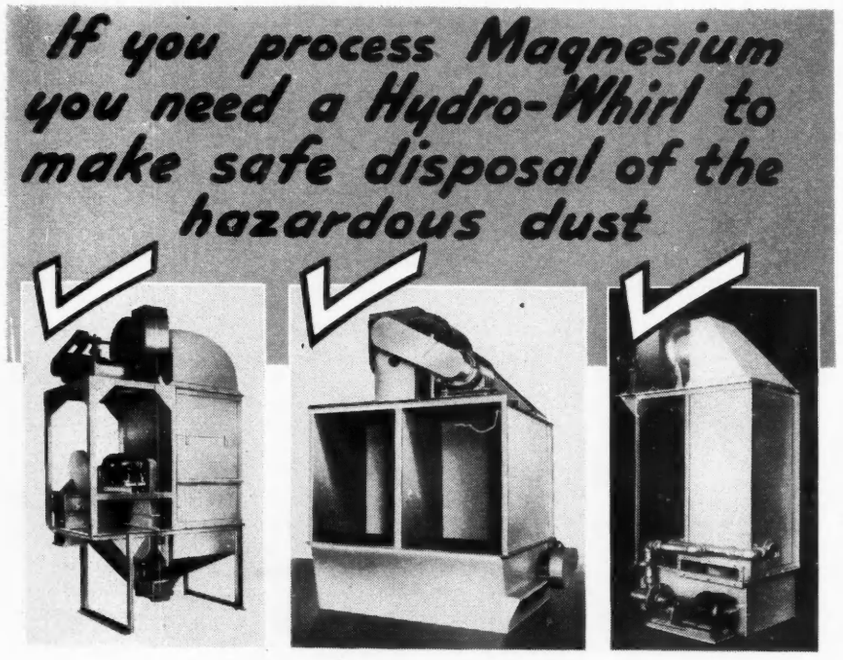
Wage rates at the Ford bomber plant at Willow Run, which the UAW-CIO can point to as a model for the industry, range from 95 cents to $1.60 per hour, with an average of about $1.15. Wages at other Michigan aircraft plants such as Continental Motors Corp., Briggs Mfg. Co., and Chrysler Corp. are correspondingly high. This makes about a 25-to 30-cent hourly differential between wages for Michigan aircraft workers and those in West Coast plants.

Latest UAW-CIO aircraft victory in Michigan was that at the Bendix Aviation Corp. plant in Wayne, where UAW received 1227 votes to 369 for "no union." Average hourly wage in Michigan aircrafts and aircraft parts plants during March was $1.196, including overtime, or a weekly wage of $58.58. This compares with a nation-wide average weekly wage for the aircraft industry of $44.80 for February.

An interim agreement eliminating overtime pay for Saturday, Sunday, and holiday work when it comes within the 40-hour week has been reached between General Motors Corp. and the UAW-CIO as a result of hearings before a special three-man mediation panel of the War Labor Board. The agreement, which covers approximately 190,000 workers in U. S. plants, provides for straight time for the first 40 hours of the work week; time-and-one-half pay for work in excess of eight hours a day, 40 hours a week, or the sixth consecutive working day; and double time for the seventh consecutive working day. However, swing shifts will be so arranged that there likely will be little double time. The agreement became effective May 25, so May 24 was the last Sunday for which double time was paid for the duration.

The agreement also covers members of the United Electrical, Radio and Machine Workers—CIO in GM plants. Meanwhile, negotiations continued before the mediation panel on other union demands for the revised contract which expired April 28, including a $1-a-day wage raise and the union shop. Other provisions of the contract have been extended until an agreement is reached, with any pay raises to be retroactive to April 28.

A threatened strike of 100 plant protection employes at five plants of Yellow Truck & Coach Mfg Co. at Pontiac brought a troop of 91 men from the military police battalion at Fort Custer, Mich., to Pontiac. Upon appearance of the troops in the city, the plant protection men called off their strike. The latter had formed an independent union but were aided in their negotiations with Yellow Truck & Coach by UAW-CIO organizers and were expected to join the latter union.



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by recognized authorities in chemical engineering

As you know, magnesium cannot be processed safely without the proper provisions having been made for an adequate and reliable method of disposing of the resulting dust.

The Hydro-Whirl has won high approbation from several notable chemical engineers, who have recognized it as one of the most efficient dust collectors on the market today.

The extraordinary efficiency demonstrated by this new principle found only in Hydro-Whirl makes its application to use with magnesium most desirable.

After being drawn into the unit, the metal dust is scientifically whirled with water and then dropped to the bottom where it collects as sludge. The cleaned air is returned to the building with no appreciable heat loss.

The units are made not only for magnesium but for the trapping of other dusts—in capacities ranging from 2,000 to 40,000 C. F. M. Made for either stand grinding or flexible shaft grinding—in single, double, or greater multiples.

Let us solve YOUR dust problems for you. There's no obligation, of course.

Industrial SHEET METAL WORKS

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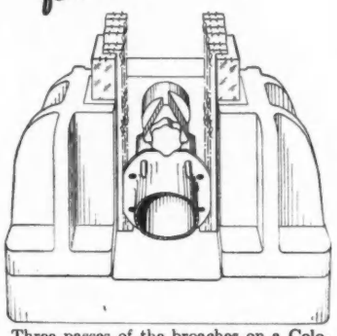
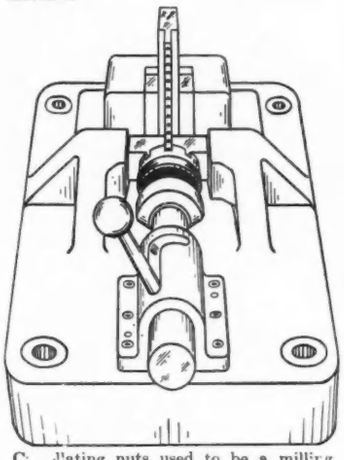
New York Office—370 Lexington Avenue

Buy Bonds for Victory

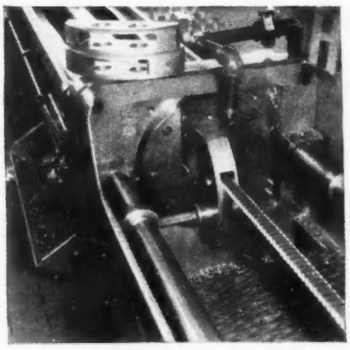
at Continental Motors for example . . .



Three passes of the broaches on a Colonial Senior press, and the flats on the cylinder flange of a radial engine are finished. The cam above the cylinder in the fixture controls the infeed for each pass. Precision and output both better than by other methods.



Circulating nuts used to be a milling job. Here is a broaching setup that answered the demand for greater accuracy in special nuts. The output also turned out to be much greater than if the nuts were milled individually. It's another three-pass job to complete, and a Colonial Senior press is used.



R & F slotting of counterweights on a single Colonial Universal Horizontal in five operations with four broaches. A typical job-lot production setup. The two counterweights give an idea of the metal removal required.

AMONG OTHER COLONIAL JOBS AT CONTINENTAL:

Broaching fuel pump drive gear. Broaching splines in generator gear, oil pump drive gear, scavenger pump gear, oil strainer nipple, generator drive gear support, etc. Broaching keyway in tachometer drive shaft gear. Burnishing such parts as vacuum pump adapter bushing, etc., etc.

In Broaching you get both . . .

Some machines are bought for the accuracy to which they can machine, some for rapidity of metal removal. The reason there is such a demand for broaching machines and broaches today is that in broaching you get BOTH.

For job lots as well as mass production —in a multitude of operations—broaching has definitely established itself as the fastest and most economical method of removing just the right amount of stock in just the right places. One Colonial standard broaching machine, for instance, will frequently equal the daily output of several machines of another type to do the same job, even though broaching may have been adopted to meet more stringent accuracy requirements.

May we suggest that you start today to look over your present and projected production setup to determine how many machines you can eliminate from your requirements by broaching?

Scheduling your future broaching machine requirements now will help to insure getting them when you need them. There is a Colonial representative in your territory who will be glad to help you.

We will be glad also to put you on the mailing list to receive "Broaching News" monthly. In it you will find varied examples of how broaching may be used to lower costs, increase production, and improve accuracy. A note on your company letterhead suffices.

COLONIAL BROACH CO.

147 JOS. CAMPAU • DETROIT, U. S. A.

Government Tin Smelter Begins Operations

New Plant Produces High-Quality Tin from Bolivian Ore; Non-Essential Steel Production to Be Further Curtailed

Initial production of tin at the Government's newly constructed smelting plant is reported to have established the superiority in quality of the metal obtained from Bolivian ores over the general run of tin that formerly came from Malaya. Very little in the way of information regarding the tonnage output of this and other Government-sponsored enterprises of a similar character is likely to be available during the war, but it is highly gratifying that analyses and tests of the early melts promise a high place for American-smelted tin in point of purity.

It is recalled frequently these days that World War I called into being a tin smelting plant in the United States, which, however, folded up shortly after hostilities ceased. This plant was operated by an English firm. With the coming of peace, tin from the East Indies became available at a price, at which continuing of smelting in the United States became unprofitable.

The dislocation in the supply of tin as a result of the invasion of the Dutch East Indies and Malaya by the Japanese has been much more acute than it was during the last war, and American-smelted tin, especially in view of its purity, is certain to enjoy a large demand after the war.

Movement of steel to war material contract plants with top ratings is being greatly helped by the War Production Board's program and policies. Several spokesmen for WPB have made it clear within the last few days that immediate increase in the supply of the direct needs of the Army and Navy, such as airplanes, tanks, guns, etc., and of steel plate for shipbuilding, is aimed at, and that to attain this objective, all else, even the construction of additional steel plants and equipment, unless these can be put into operation this year, will have to give way.

As for items that are of secondary importance in carrying out the war program, they are being speedily eliminated as possible loopholes for the diversion of steel. The recently promulgated list of 400 forbidden uses of steel is being enlarged and before long will probably exceed one thousand. What is more, C. Henri Rush, chief priority specialist of WPB, said the other day at a round table discussion, "When a stop production order is issued, we mean: Stop, stop! Unless a manufacturer can clearly show that the was effort is being hindered, appeals will be useless." Manufacturers should speedily dispose of excess inventories of parts, and in many cases, said Mr. Rush, the argument that partly fabricated materials could not be used by any one but the owner had been shown to be a fallacy.

Army, Navy, Maritime, and lease-lend will take two-thirds of the current quarter's steel output. Industries, essential in the carrying out of the war program and in the maintenance of the most important civilian activities, such as farming and mining, will split what remains. There are some unpleasant facts to be swallowed by thousands of steel consumers, but they are being stated with more and more preciseness, and, as a result, is much better understanding between the authorities and business is being attained.

Price adjustments are being effected without friction, OPA considering each appeal on its individual merits. A number of non-integrated steel companies were granted price relief for the very reason that they have to obtain their semi-finished material from others, while a maker of merchant bars was denied permission to raise prices of his products. Steel mills have been instructed to build up scrap inventories to the limit during the summer.

Safeguarding the Lifeblood of Aircraft

● Gas and oil lines—the circulatory system of a plane—are small but important factors in air supremacy for the Nation.

As a manufacturer of precision parts Dole has for many years produced to the closest specifications. The tolerances of aviation were neither new nor an obstacle. Already the major airplane companies served, have confirmed the ability and accuracy shown in Dole Products.

To Air Corps, Navy and "AN" Specifications

THE DOLE VALVE COMPANY
(Incorporated 1906)
1901-1941 Carroll Avenue, Chicago, Illinois
ALBANY · DETROIT · LOS ANGELES

DOLE FITTINGS ★ ★ ★ ★ ★ ★ ★ and VALVES
For Aircraft Pipes & Tubes

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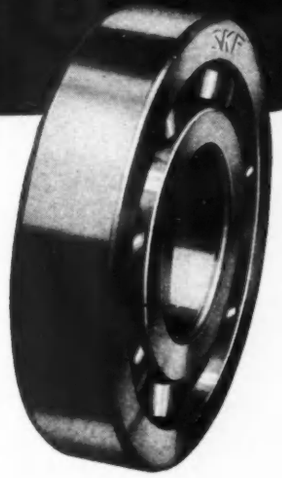
SKF

BALL AND ROLLER
BEARINGS



Buses

LAST *with* SKF *Bearings*

Now that manufacturers of trucks and buses are switching over to war production, commercial bus owners must make their existing equipment LAST. And one item to which they're paying particular attention is bearings. By replacing with SKF's, they're saving untold thousands by keeping rotating parts in proper places, lowering maintenance costs, guarding against bearing breakdowns—making sure of performance for many years to come.

5006

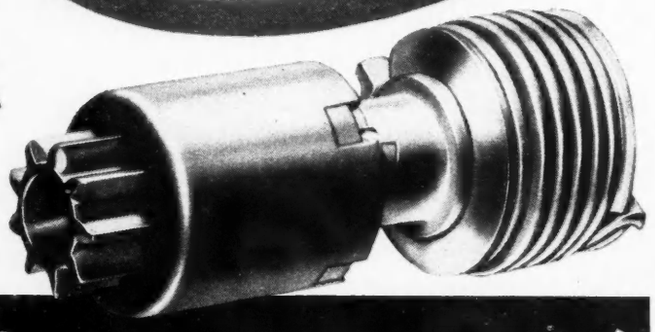
SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA., PA.

Press Assoc.

Curtiss C-46, Army Transport

Designed to transport troops, reconnaissance cars, and field artillery this giant all-metal troopship has a wing span of 108 ft, weighs 50,000 lb and is described as "the world's largest twin-motored airplane." Known as the C-46, the plane is the first of a large number ordered for the U. S. Army Air Force.

★THE START OF STARTING SATISFACTION



because

it's better to start with!

WHATEVER the engine application — in trucks, cars, tractors, industrial units or marine power plants — the specification of genuine Bendix Drive is a sound step in assuring starting satisfaction.

You gentlemen whose appraisal is most valid and valuable have very clearly indicated that this is your considered opinion, by embodying Bendix Drive in more than fifty million engines.

Owners and operators, who take the reliability of genuine Bendix Drive for granted, have over the years, received lasting satisfaction from your decisions.

Today's — and tomorrow's starting requirements will be safely served by this veteran of billions of satisfying starts.

ECLIPSE MACHINE DIVISION
BENDIX AVIATION CORPORATION
ELMIRA, NEW YORK

BENDIX DRIVE

ADVERTISING

Henry T. Ewald, president of Campbell-Ewald Co., has been awarded the University of Missouri's school of journalism medal of honor for "advancement and betterment of advertising."

Bower Roller Bearing Co. has placed its advertising account with **Creative Agency Associates, Detroit.** The account executive will continue to be William B. Hall, who has handled it for 11 years.

BOOKS . . .

HANDBOOK OF MECHANICAL DESIGN, *by George F. Nordenholt, Joseph Kerr, and John Sasso. Published by McGraw-Hill Book Company, Inc., New York.*

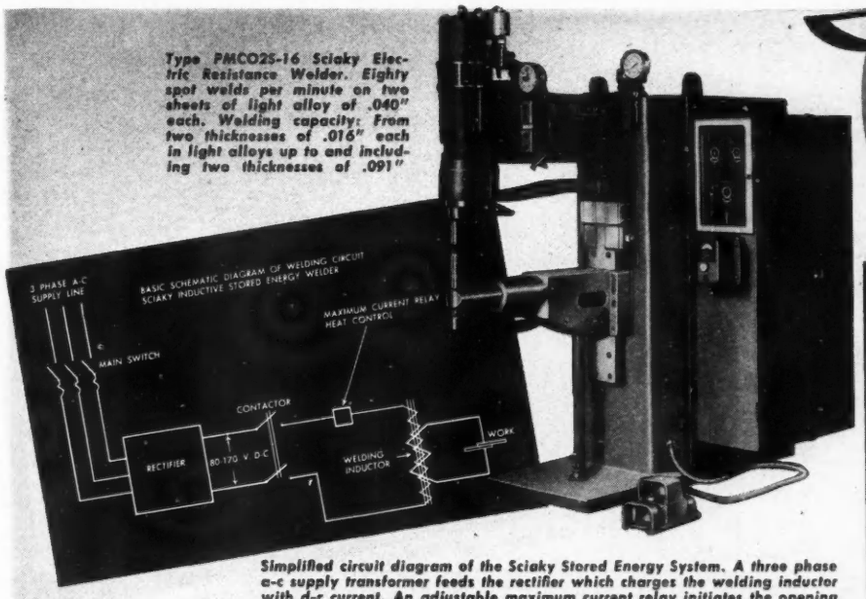
This is a compilation of technical data from the pages of *Product Engineering.* The subjects covered include Materials, Beams and Structures, Latches, Locks and Fastenings, Springs, Power-Transmission Elements and Mechanisms, Drives and Controls, and Design Data on Production Methods. Much of the information is given in the form of tables, charts and monograms. The book is well illustrated.

HANDBOOK ON DIESEL ENGINES, *prepared by L. H. Morrison. Published by Diesel Publications, Inc., New York.*

The author states in the preface of this new handbook that it was compiled to give the reader specific information about the various modern Diesels. It is his conviction that most handbooks on this subject are too general in their treatment of the subject. After several introductory chapters explaining the theory of operation, the book gives specific data on the maintenance and operation of eighteen makes. The chapters are well illustrated and contain many cross sections together with wiring and timing diagrams, and fuel system layouts. The last two chapters are devoted to the description of two makes of fuel-injection pumps.

AMAZING POWER COST SAVINGS

WITH THE SCIAKY* PROCESS FOR SPOT WELDING ALUMINUM



Type PMCO2S-16 Sciaky Electric Resistance Welder. Eighty spot welds per minute on two sheets of light alloy of .040" each. Welding capacity: From two thicknesses of .016" each in light alloys up to and including two thicknesses of .091"

Simplified circuit diagram of the Sciaky Stored Energy System. A three phase a-c supply transformer feeds the rectifier which charges the welding inductor with d-c current. An adjustable maximum current relay initiates the opening of the d-c charging circuit after a predetermined amount of electromagnetic energy has been stored in the inductor.

Electric resistance welding of aluminum and its alloys requires currents of extremely high intensity. (For example, a secondary current of approximately 150,000 amperes is required for spot welding two pieces of 3/16" aluminum alloys.) When a spot weld is made by a conventional A-C SINGLE PHASE Welder, the sudden demand on the supply line unbalances the line and causes a severe voltage drop.

Not only is the resulting "flicker" an annoying nuisance, but the *maximum demand* is boosted to a point where power costs become prohibitive. A battery of such welders requires special, expensive, heavy-duty power lines to handle the peak loads, *if indeed the power is available.*

Utilizing the stored energy principle, the Sciaky Welder has a peak demand of approximately 1/10th that of an a-c machine of comparable capacity. The Sciaky method uses three phase 220 to 550 a-c which is rectified and reduced to 80 to 170 volts d-c. This direct current is stored in the form of electromagnetic energy in a welding inductor during a "charging" period, and then released practically instantaneously as low-voltage, high-amperage welding current. Moreover, a balanced condition is maintained on all three phases of the supply line at near unity power factor.

The stored energy principle, the patented variable pressure cycle and an exclusive preheating feature have made the Sciaky Process for aluminum welding preferred by practically every major producer of aircraft in America.

SCIAKY BROS.

Manufacturers of a Complete Line of D-C and A-C Electric Resistance Welding Machines

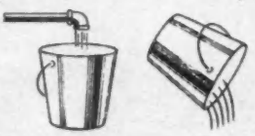
11001 Cottage Grove Avenue, Chicago, Illinois

***Pronounced See-ack-ee**

Stored Energy DOES IT!

WHY STORED ENERGY REDUCES POWER COSTS

SCIAKY D-C WELDING REQUIRES *LOW* "MAXIMUM DEMAND"



The analogy of a water pipe and pail illustrates the stored energy principle. The pail is filled from a comparatively small pipe and its entire contents dumped in a fraction of the filling time. This parallels the comparatively slow (actually, a fraction of a second) storage of electromagnetic energy, and its instantaneous release as welding current.

CONVENTIONAL A-C WELDING REQUIRES *HIGH* "MAXIMUM DEMAND"

To continue the analogy, the demands on the power lines by an a-c welder, by comparison, would require a pipe large enough to supply instantly, a volume of water equivalent to the entire contents of the pail. It is this excessive "maximum demand" that runs up the cost for current.

SCIAKY — **PROCESS ELECTRIC RESISTANCE WELDING**
STORED ENERGY • VARIABLE PRESSURE

Company Schools Train Army, Navy Personnel

Maintenance of Engines, Guns, Field Pieces Taught in Schools Operated by Ford, Packard, Several GM Units

Furthering the General Motors Corp. program of training Army and Navy personnel in the operation of its war products, several more GM divisions have opened intensive instructional schools. With the Air Corps demanding many more mechanics to service the 60,000 airplanes scheduled to be built this year, Buick Motor Division has started a three-month training class to teach mechanics in the servicing of radial aircraft engines. The enlisted personnel of the Air Forces will be given instruction in the overhaul, service, and repair of Pratt & Whitney. bomber engines which Buick is producing at a new plant in Illinois.

The Buick training activity is centered in a Buick service plant at Flint. The men will be quartered at a nearby auditorium during their training period. Buick's teaching staff is composed of 36 company men, having a background of mechanical training, drawn from all sections of the country. Besides their automotive experience, these men have undergone an intensive two-month special training routine in aircraft engineering.

Air Corps enlisted men selected to attend the school will be chosen on the basis of aptitude tests. They will attend classes from 8 a. m. to 5 p. m., six days a week. Approximately 25 per cent of the instruction time will be spent in classrooms and the rest in manual instruction, teardown, and overhaul. Twenty-two Buick-built aircraft engines will be used for this practical work.

The first week of the course will be devoted to basic aircraft engine design and aerodynamics. The second week will take up the propeller shaft and reduction gear assemblies, the use of hand tools, precision instruments, and drawings. Succeeding weeks will cover the power section, the blower, the induction system, inspection methods, aircraft materials, assembly and disassembly of engines, engine adjustment, electrical equipment, accessories and engine test. Examinations will be held at the end of each week's work and a minimum grade of 70 must be achieved if the student is to remain in the course. The first class will graduate in July and eventually the school enrollment is expected to number several hundred enlisted men. New classes will enroll each week. William B. Hufstader, Buick general sales manager, is director of the training course.

Ford and Packard also are conducting schools for Air Corps mechanics and Chevrolet expects to open one in the near future.

Two other GM divisions, Pontiac and Oldsmobile, are conducting schools for members of the armed forces to instruct them in the use and maintenance of the guns which these divisions are manufacturing. Pontiac Motor Division is operating an anti-aircraft gun training school to furnish instructors and observers for naval training centers on the Atlantic and Pacific coasts. The four-week course is held in one of the Pontiac armament plants. Eventually the school also will embrace instruction on the 40-mm. anti-aircraft gun which Pontiac will produce for the Army.

More than 300 Army and Navy officers and enlisted men are attending the Oldsmobile gun service school at the Olds engineering building in Lansing. Students are trained in the use and maintenance of the various types of guns produced by Oldsmobile and other GM divisions, including aircraft, tank, and field weapons.

WE'LL RUSH YOU A WELLS SAW

TO HELP SPEED YOUR PRODUCTION !

We can send a fast, accurate Wells Saw . . . "Rush Delivery." Quickly installed in your plant, it will soon be at work increasing your production capacity . . . stepping up metal cutting time!

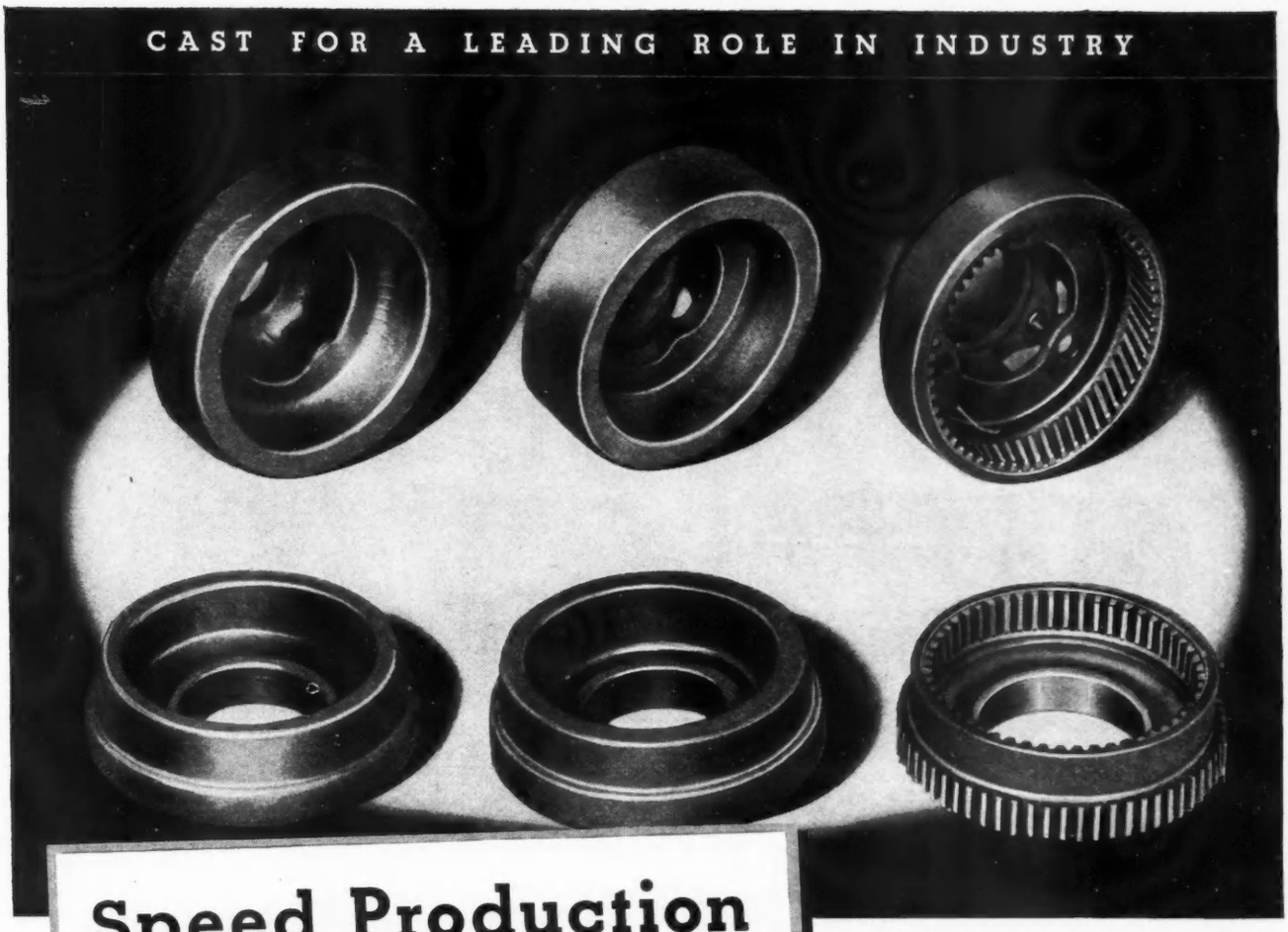
The Wells Metal Cutting Band Saw, an all-around tool for production, tool room or maintenance work gets results — quickly! These precision-built units handle almost all metals in a variety of shapes.

Rugged Wells Saws meet all government specifications. A large stock of blades always available. Wire, write or phone direct or to your mill supply dealer.

WELLS MANUFACTURING CORP., THREE RIVERS, MICH.

WELLS METAL CUTTING BAND SAWS

CAST FOR A LEADING ROLE IN INDUSTRY



Speed Production with ArmaSteel*

ARMASTEEL TRANSMISSION PARTS
(Top) Rear unit internal gear and carrier —forging, 6.45 pounds; ArmaSteel rough casting, 5.2 pounds; finished part, 2.6 pounds. (Bottom) Reverse internal gear — forging, 8.4 pounds; ArmaSteel rough casting, 7.5 pounds; finished part, 4.8 pounds.

†TYPICAL APPLICATIONS
Diesel pistons for heavy-duty locomotives and trucks . . . Automotive pistons, piston rings, camshafts, Hydra-Matic transmission gears, drive-shaft universal yokes, clutch throw-out collars, valve rocker arms . . . Refrigerator crankshafts and connecting rods . . . Washing machine drive gears.

GM SAVE SERVE

Long before any shortage of metals existed, ArmaSteel castings were adopted by industry to speed production, reduce costs and improve performance characteristics on many vital parts.†

Among the qualities and properties of ArmaSteel which led to its adoption are: High yield strength and yield ratio, high fatigue life, high hardenability, adaptability to selective hardening, high wear-resistance, excellent bearing properties, high damping capacity, high corrosion-resistance and exceptional machinability. To these considerations is added the inherent advantage of castings in reducing the amount of machining required to produce a finished part. Savings up to 50 per cent in man-hours of machining time can be effected with ArmaSteel castings.

Manufacturers faced with a shortage of materials, and interested in applying the advantages of ArmaSteel to their production, may avail themselves of our laboratory resources, our technical knowledge and our 23 years of practical foundry experience.

Write for catalog containing detailed information and specific properties of ArmaSteel.

Saginaw Malleable Iron Division
General Motors Corporation, Saginaw, Michigan
*Reg. U. S. Pat. Off.

CAST FOR A LEADING ROLE IN INDUSTRY

New Field Engineering Offices

The Cincinnati Milling Machine Co., manufacturers of milling, broaching and cutter sharpening machines, and Cincinnati Grinders, Inc., manufacturers of grinding and lapping machines, will on June 1st serve their customers in New York State and New England through their sales subsidiary, Cincinnati Milling and Grinding Machines, Inc., with district offices located in New York, Hartford, Boston, Buffalo, and Syracuse.

Henry Prentiss & Co., Inc., who have acted as the companies' exclusive dealer in New York State and New England since 1887, have announced their retirement from active business on May 31.

To Build Ambulances

H. H. Shuart, for many years secretary of the Detroit Auto Dealers Association, has been named manager of a division of the A-B Stoves, Inc., Battle Creek, Mich., that will manufacture a first aid ambulance unit which converts a passenger car into an emergency ambulance.

• If one of your problems is springs — dependable springs, that you must have in reliable quantities to keep your production at its peak—perhaps we can help you.

With our organization running in smoother-than-ever form we are producing more and faster and better products—to help you produce more, faster and better. We've learned short cuts and through experience have accumulated "know how" that is saving much time, trouble and headaches.

That is why we feel that your seemingly tough spring problem may find an easy answer here at Accurate. If you will show us what type—how many—and when you need springs or wireforms, we'll come up with answers you may find pleasantly surprising.

Send for the new Accurate "Handbook of Technical Data". It's handy, compact, informative. You'll be glad to have it.

ACCURATE SPRING MFG. CO., 3811 W. Lake St., Chicago, Ill.

Mack Announces New Service Department

As a further aid to the nation's war effort, Mack Trucks, Inc., announces the formation of a Government Service Engineering Dept., charged with the task of advising Army personnel in the proper servicing, repairing, and handling of Mack trucks now at army camps and military posts throughout the country. The new department, under the management of Charles F. Drumm, comprises a field force of trained Mack service engineers with headquarters at the home office, and district and divisional service managers in 70 different cities who will make regular inspection trips to the various camps.

Sperm Oil Placed Under Full Allocation

Sperm oil, widely used in industry, has been placed under complete allocation by the Director of Industry Operations through the issuance of Amendment No. 1 to Order M-40.

The order provides that all users must file monthly on Form PD-481 requests for allocation of sperm oil for the following month. These requests need not be filed for permission to import sperm oil into the United States; or pursuant to Army, Navy, and Maritime Commission contracts.

All persons who, on May 31, 1942, had a thousand pounds or more of sperm oil in inventory must report on Form PD-482 by June 15. Importers must inform the War Production Board, by letter, within ten days after an importation reaches this country, giving all pertinent details.

Special restrictions are placed upon the use of sperm oil in the production of lubricating oils and greases.

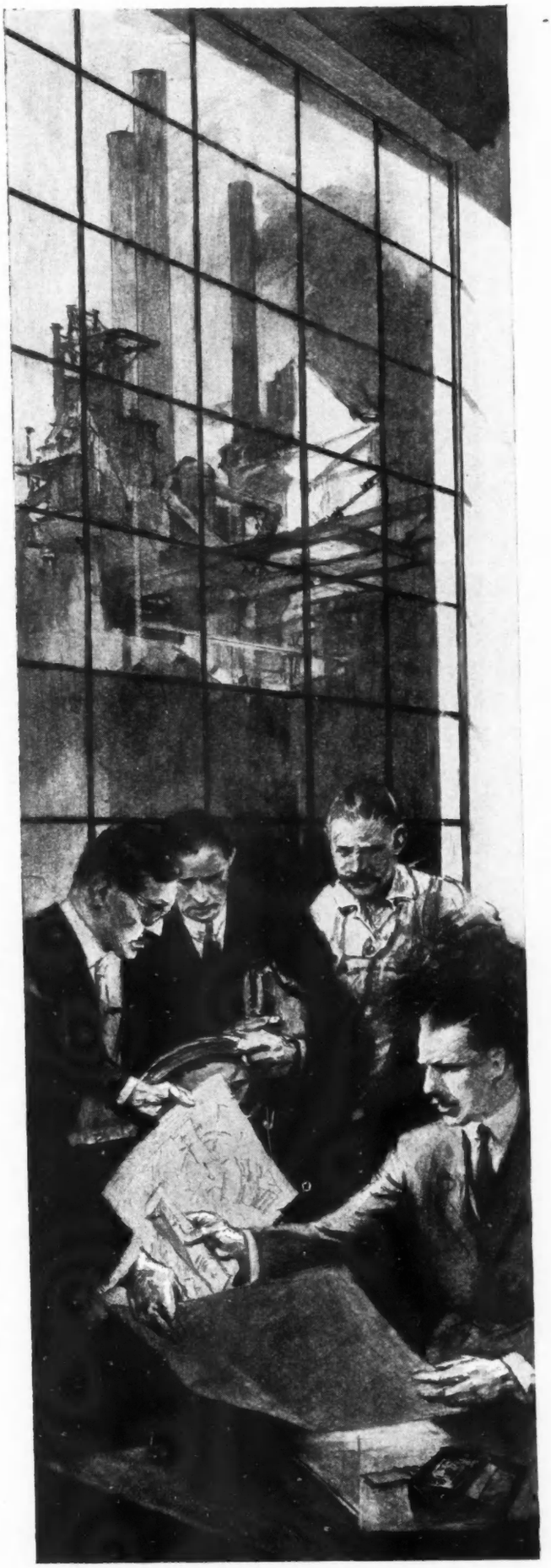
40 YEARS AGO

Simply because it is easier and more natural, and not from inherent considerations, it uses at the present time a comparatively scarce, expensive and dangerous material—gasoline—of which the supply is so limited that it will hardly suffice to see the automobile out of the "plaything" stage.

At any rate, gasoline must before very long be relegated to other uses than that of serious and extensive power generation; alcohol can hardly be considered in this country in view of the relatively low price of petroleum and the state of the excise laws; acetylene is not to be thought of, and thus kerosene or other heavy petroleums must naturally be looked to as the fuel of the future for the motor of the future, the internal combustion engine, which is only just beginning to receive its justly deserved inheritance from the steam engine.

Once give the industry a tire which can be considered a business proposition, a kerosene internal combustion motor, workmanship up to the "locomotive" standard throughout, and the "horseless age" will be, if not at hand, well on the way.

From *The Horseless Age,* May, 1902.



THE KNOW HOW

● "Know How" to seasoned men of industry means the combination of skill and resourcefulness that comes from experience. It implies the ability to do a job with the tools and materials at hand. It assumes that the job will be well done and on time.

Never before in our Country's History has the American "Know How" been so challenged. Never has such a challenge been so answered.

Building ships, guns, planes and the huge machines on which they are made in mass production takes "Know How" and plenty of it. It also takes "Know Who" and "Know Where". Who is the best equipped to make a certain part? Where is the plant located? How many can they turn out in the time allowed? In the answer to these questions is the answer to the challenge which war has hurled at American industry. In it is also the explanation of the fact that our 1942 production will be nearly ten times as great as in 1939.

There are more than 100 other plants contributing to this ever-growing torrent of production for war. Our job has been to utilize their facilities to the utmost and to co-ordinate them with our own. The one thing that has done most to make all this possible is the Great American "Know How". It is what our enemies did not count on; cannot understand. It is what will equip America's armies to win the war, the peace, and all that follows.

GENERAL MACHINERY
CORPORATION
HAMILTON, OHIO

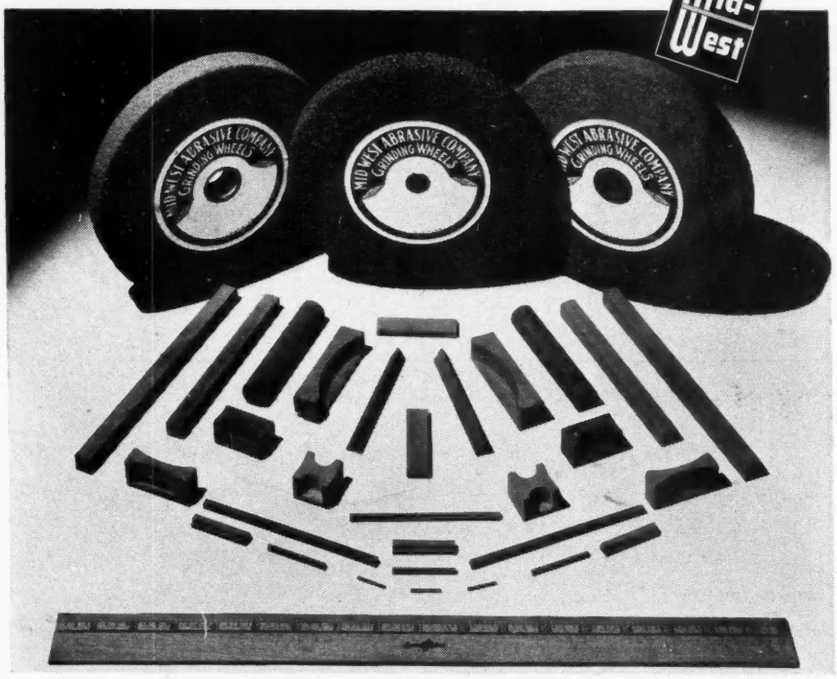
THE NILES TOOL WORKS CO.
THE HOOVEN, OWENS, RENTSCHLER CO.
GENERAL MACHINERY ORDNANCE CORPORATION

Four-Wheeled Mules

These Army Jeeps, under test by the Department of Agriculture's Tillage Machinery Laboratory, demonstrate one use to which they may be put when post-war surpluses become a problem.

"EFFECTIVITY" ..

Mid-West



You won't find "effectivity" in your dictionary but you will find lots of it in MID-WEST honing stones and grinding wheels because we coined the word to describe the longer, more effective wearing quality that has made MID-WEST products the most efficient abrasives in America.

MID-WEST honing and Superfinishing stones, in actual production, have established new records for *efficiency, service* and *economy* and all three of those factors are derivatives of "effectivity." MID-WEST stones have longer "effectivity" because they wear down evenly, don't chip along the edges and generate as much as 90 per cent less heat than do ordinary abrasives. These high quality stones, made with remarkable new Micro Bond and designed for *precision* work, are produced under a *precision* process during which the grain structure, hardness, size, shape and balance are CONTROLLED to the final degree. Why not let a MID-WEST engineer help you solve your honing problems? Samples shipped from stock immediately.

MID-WEST ABRASIVE COMPANY

Manufacturers of grinding wheels, sandpaper and emery cloth.

2189 BEAUFAIT DETROIT, MICHIGAN

MID-WEST ABRASIVES

Replacement Parts

(*Continued from page* 48)

to chrome, tin, rubber, aluminum, and other metals has been made more acute by the Government war policy of supplying the needs of Russia and other of the United Nations that are actively engaged in fighting the Axis before taking care of domestic needs.

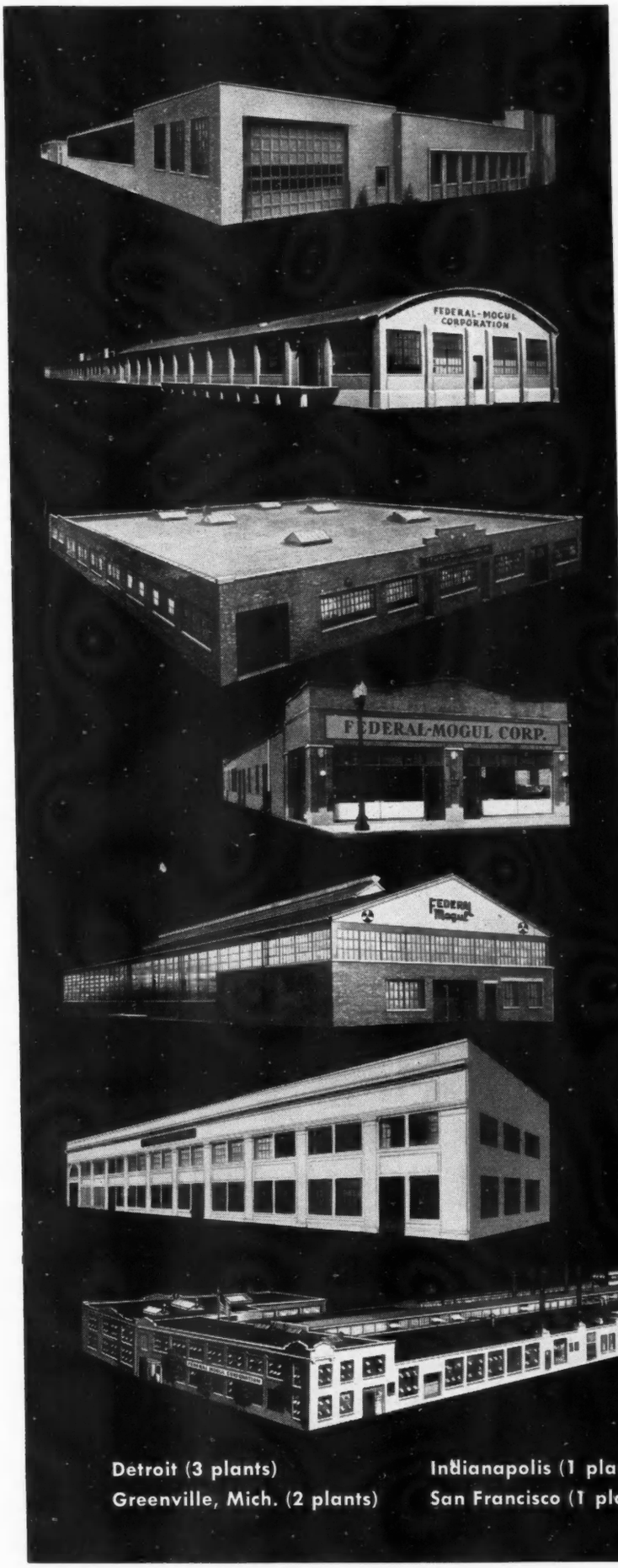
Kanzler asserted that the WPB was emphatic in urging that the tires on private cars must be conserved, with the possibility that requisitioning might eventually be necessary to provide essential transportation for the Nation. He said the public could expect no synthetic rubber for civilian use before 1944, if then. Gasoline rationing is a method of automatically regulating the use of motor cars and conserving their tires.

Motors trucks are being rationed at the rate of more than 3000 per week and at that rate the present supply of 144,506 units will be exhausted by January, 1943, R. L. Vaniman, Deputy Chief of the Automotive Branch, told the Detroit Auto Dealers' Association at a meeting held in Detroit, May 26. The stock of frozen trucks was originally intended to last until December, 1943.

Eighty-two per cent of the trucks rationed so far have been under classifications I and II for use in military or police work, fire fighting, health and communication services, transportation of war materials, defense housing, and communication. Future rationing largely will hinge upon the rubber situation.

Correction

In the May 15 issue of AUTOMOTIVE *and* AVIATION INDUSTRIES, page 47, column 2, the statement from the International Harvester Co. reading: "We are convinced . . ." should read: "We are *not* convinced . . ."



ABILITY
and
FACILITIES
TO PRODUCE

•

Seven strategically located plants, each specializing in its portion of a capacity-production program, are turning out all types and sizes of sleeve bearings, bushings and similar precision parts for war requirements. Standard production ranges from the largest Diesel bearings to small motorcycle and compressor sizes. The manufacturer with a bearing problem (and a priority rating) is invited to consult us.

FEDERAL-MOGUL CORPORATION
DETROIT, MICHIGAN

•

Sleeve bearings and bushings and similar precision parts designed, developed and manufactured for engines, pumps, compressors, large machine tools and all applications where such parts are used. Established 1899.

Detroit (3 plants)
Greenville, Mich. (2 plants)
Indianapolis (1 plant)
San Francisco (1 plant)

FEDERAL Mogul

Reports on Alcohol Production Facilities

A report on the alcohol-making facilities of the United States and the outlook for this year and next was made recently by A. I. Henderson, Director of Materials.

Military and essential civilian demand for 1943 is now estimated at 476 million gal., including 200 million for butadiene, an ingredient of synthetic rubber. Production capacity is estimated at 540 milion gal., to which will be added a stockpile of 50 million gal. surplus from 1942.

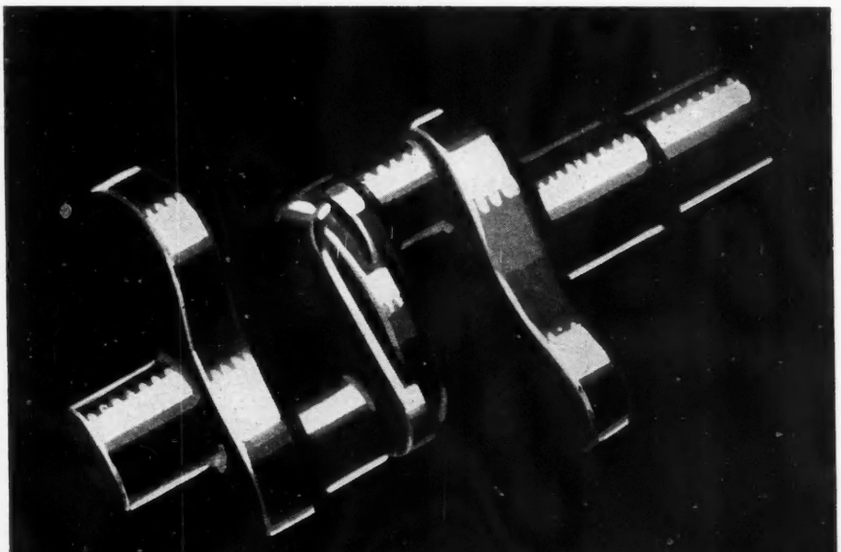
This production capacity will be achieved by conversion of the whiskey distilling industry to industrial alcohol and full-time operation of all industrial alcohol plants in the country.

This is the way the total will be reached:

	Gal.
Synthetic (from ethylene gas)..	65,000,000
Whiskey plants now making 190 proof	120,000,000
Whiskey plants to be converted.	120,000,000
New Orleans industrial alcohol plants	65,000,000
Seaboard industrial alcohol plants	160,000,000
Cuba and Mexico	10,000,000
	540,000,000
Surplus from 1942.....	50,000,000
	590,000,000

Practically all this production will be made from grain. Beverage alcohol plants use grain exclusively, of course, and grain handling equipment now is being installed in all eastern seaboard plants so they can use either grain or blackstrap molasses, if the latter is available. Because sufficient blackstrap, residue from sugar production, is available at New Orleans from domestic sources, plants in that area will continue to use it. Blackstrap from seaboard plants came, in the past, from Cuba and other sugar-producing islands off the east coast.

The 1943 program will consume approximately 136 million bushels of grain. Corn, rye and wheat now are being used, in approximately that order, but a large increase in the use of wheat for alcohol production is being arranged. The larger part of new installations will depend on wheat as the source material.



It has been the privilege of Wyman-Gordon to participate in the engineering and manufacturing development of aviation, all along the way. Since the dawn of aviation, Wyman-Gordon forgings have been factors in the accomplishment of the reliability of air travel.

Today, with every forging laboratory controlled, Wyman-Gordon is producing crankshafts, cams, propellers and other vital parts, night and day, at full speed.

WYMAN-GORDON

WORCESTER, MASS.
HARVEY, ILL. DETROIT, MICH.

New Propeller Plant

Flag raising ceremonies for the new $25 million plant of the American Propeller Corp. were held May 20 at Toledo. The plant will produce hollow steel propeller blades from seamless steel tubing. William F. Wise, executive vice-president of Aviation Corp., of which American Propeller is a subsidiary, is president of the company.

Ex-Cell-O Vice-President

James K. Fulks, recently appointed Vice-President in Charge of Manufacturing of the Ex-Cell-O Corp., Detroit, Mich., joined the company in 1925. Since then he has gained experience in all practical phases of the company's production of precision machine tools and parts. Ex-Cell-O is now entirely engaged in vital war production.

What Shortage?

Rubber is not the *only* flexible, resilient material, nor tin and copper the *only* pliable, non-corroding materials. Skilled engineers of Acadia Synthetic Division of Western Felt Works have long been preparing to supply new and improved substitutes for aviation and automotive equipment. Now they are ready.

ACADIA *Synthetic* RUBBER

With many of the characteristics for which rubber was used when plentiful, Acadia Synthetic Rubber ALSO offers greater resistance to aging, heat, sunlight, alcohol, oils, kerosene and for many solvents. Already widely used for washers, gaskets, diaphragms, etc., unlimited new applications are being found with the co-operation of Acadia's experienced engineers.

SARAN *Thermoplastic* TUBING

Has unusual tensile, great flexibility and a high bursting strength — in many ways superior to copper tubing. Stands up under acids, heat, tool-abuse, moisture, etc. Saran products are fabricated under license from Dow Chemical Company in a wide range of sizes.

SEND *Today* for complete details on Acadia products.

ACADIA SYNTHETIC PRODUCTS DIVISION
WESTERN FELT WORKS
Processors of Synthetic Rubber and Saran Plastic Tubing and Sheet
Chicago, Illinois: 4035-4117 Ogden Avenue
Detroit, Mich.: 420 Stephenson Bldg.
Branch Offices in All Principal Cities

Powder Metallurgy

Its Rapid Expansion and Its Importance in the War Economy

(*Continued from page* 31)

of dies and equipment. Moreover, there are limitations as to shape and size. But these are not as serious as they sound considering that many intricate parts have been produced commercially in recent months. Another point is that the choice of metal powders must be appropriate to the application. And here again the engineer can draw upon the technical experience of the specialists in this field.

The field of powder metallurgy may be properly divided into two basic activities: (a) the production of high purity metal powders, and (b) the manufacture of parts with metal powders. We list elsewhere the names of companies engaged in each of these activities.

Quoting from a letter by the Metals Refining Co., producers of powdered copper, lead, iron, and tin: "It appears that metal powders are playing a very important part in the present war program. We find considerable metal powder, with high priority ratings, going into bearings, clutch facings, electrical brushes, and brake compositions. It appears that there may be a tendency to substitute iron powder, or a combination of iron powder and copper powder, for porous bearings. This may be explained by the apparent shortage of copper and tin.

"There also appears to be a tendency toward the production of compressed and sintered parts made from metal powders in view of the fact that no machining is required with a subsequent production of scrap material. In general, small pressed parts that adapt themselves to powdered metallurgy compressing are finding increased application in our present defense program."

The American Metal Co., Ltd., a producer of copper powders formulated according to the requirements of its customers, has considerably increased the facilities of its refinery. This material is used in large quantities in the making of porous bearings, in sintered metal friction devices, in the carbon brush industry, and as component in anti-fouling marine paint.

Some impression of the widening sphere of the powder technique may be gained by noting the variety of products developed recently by the Moraine Products Div., General Motors Corp. Let us consider, first, the use of Durex iron as a substitute for critical materials in automotive products:

AUTOMOTIVE

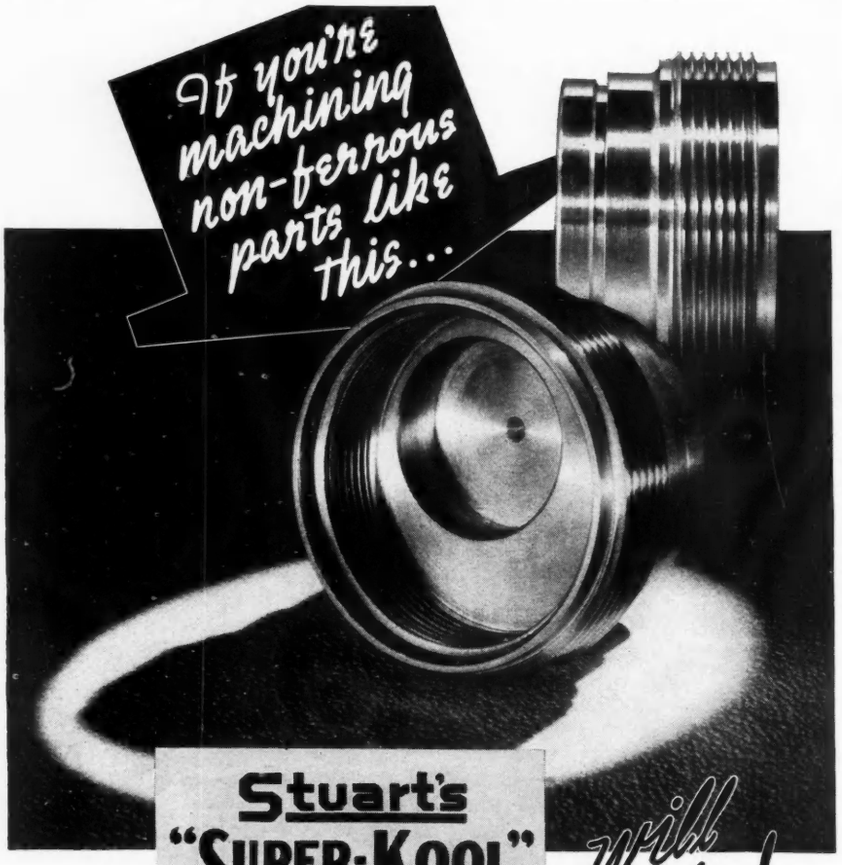
Rear axle thrust washers (were bronze)
Camshaft thrust washers (were bronze)
Transmission thrust washers (were bronze)
Hardware parts (were die cast and screw machine)
Heater and defroster fan bearings
Chassis bearings
Oil pump gears

More recently, Moraine has turned its energies to the production of parts of Durex bronze as outlined below:

AIRPLANE

Instruments
Engine mounts
Accessory drives
Carburetor shafts
Pulleys
Controls
Bomber turret parts
Machine gun mount parts
Bomb rack parts
Link trainers
Propeller parts

Amplex Div., Chrysler Corp., is now producing parts for ordnance equipment and for other war products such as airplane engines, etc., for the Army and Navy. Among its latest powder materials is Super-Oilite, a sponge iron composition, which is satisfactory for



Stuart's
"SUPER-KOOL"
America's First Transparent Sulphurized Cutting Oil

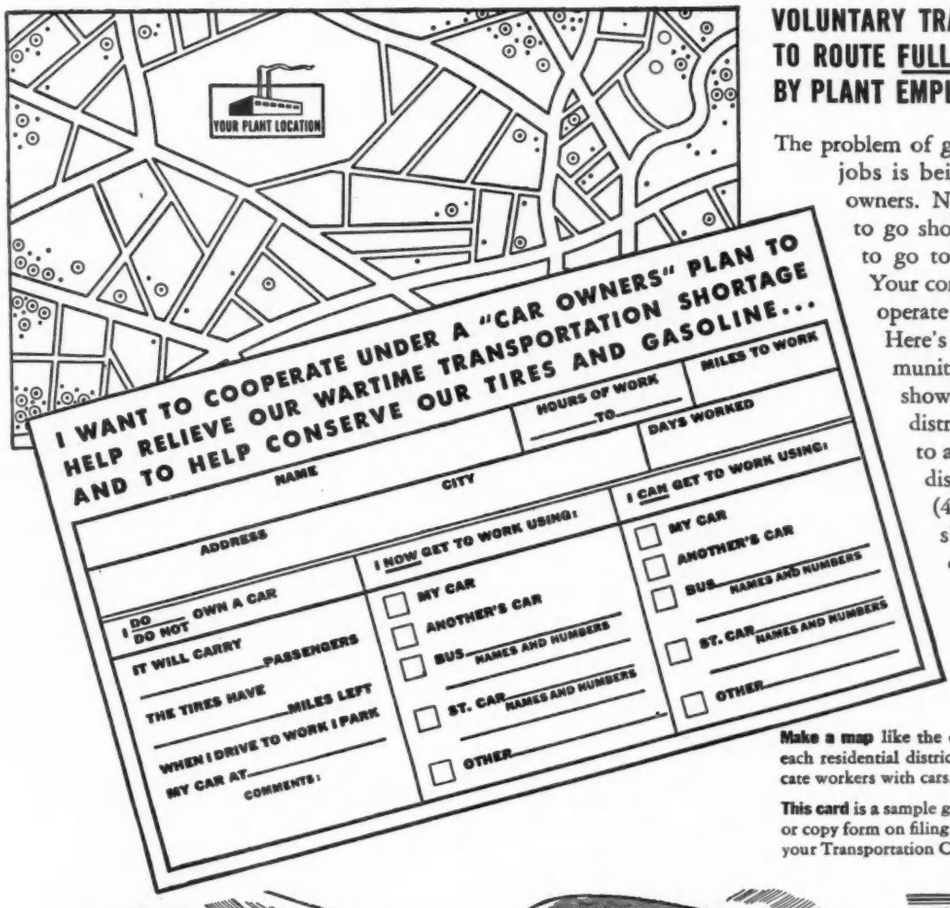
with help!

IN the production of brass and aluminum fuses the reduction of "down time" to the least possible degree is all important!

Cutting operations on multi-spindle automatics, such as reaming, eccentric drilling, tapping and threading, respond to the application of Stuarts "Super-Kool" No. 151 Brass Cutting Oil, or Stuarts "Super-Kool" No. 1M Aluminum Cutting Oil frequently with a surprising improvement in tool life and finish.

For All Cutting Fluid Problems
D. A. STUART OIL CO.
Chicago, U.S.A. • LIMITED • Est. 1865
Warehouses in All Principal Metal Working Centers

MANY LARGE COMPANIES ARE NOW TAKING A CENSUS OF EMPLOYEES' CARS AS PART OF NATION'S PROGRAM TO GET 40,000,000 WORKERS TO THEIR JOBS ON TIME


YOUR PLANT LOCATION
I WANT TO COOPERATE UNDER A "CAR OWNERS" PLAN TO HELP RELIEVE OUR WARTIME TRANSPORTATION SHORTAGE AND TO HELP CONSERVE OUR TIRES AND GASOLINE...
NAME
CITY
HOURS OF WORK
TO
MILES TO WORK
DAYS WORKED
ADDRESS
I DO / DO NOT OWN A CAR
IT WILL CARRY PASSENGERS
THE TIRES HAVE MILES LEFT
WHEN I DRIVE TO WORK I PARK
MY CAR AT
COMMENTS:
I NOW GET TO WORK USING:
MY CAR
ANOTHER'S CAR
BUS NAMES AND NUMBERS
ST. CAR NAMES AND NUMBERS
OTHER
I CAN GET TO WORK USING:
MY CAR
ANOTHER'S CAR
BUS NAMES AND NUMBERS
ST. CAR NAMES AND NUMBERS
OTHER

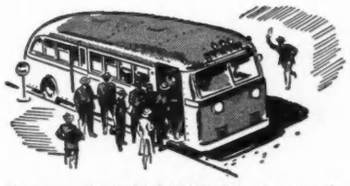
VOLUNTARY TRANSPORTATION COMMITTEES TO ROUTE FULL CARS TO WORK ARE SET UP BY PLANT EMPLOYEES IN EACH COMMUNITY

The problem of getting 40,000,000 workers to their jobs is being taken over by America's car owners. Neighbors are already doubling up to go shopping, to take children to school, to go to work . . . *but not enough of them!* Your company and your employees can co-operate by taking a census of workers' cars. Here's how you can do it in your community: (1) Fill out cards, like the one shown here, (2) Sort cards by residential districts, (3) Select sectional committees to act as traffic control groups for each district to assure equitable use of cars, (4) Route *full* cars to work on every shift. Details can be worked out quickly by you . . . your workers . . . your community. The important thing is to start today to get every last mile of use from our cars, our gas, our tires!

Make a map like the one above, on which to chart the routes for each residential district. Dots indicate workers' homes; circles indicate workers with cars.

This card is a sample guide. Make changes to suit your needs. Reprint or copy form on filing cards for each worker to fill out and turn in to your Transportation Committee.

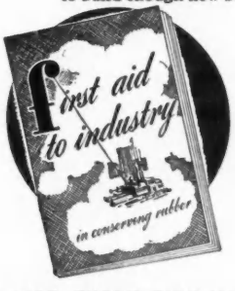
Trolleys can't do it ALONE. Even with staggered work hours to level off transportation peaks there aren't enough trolleys to take America's millions to work.



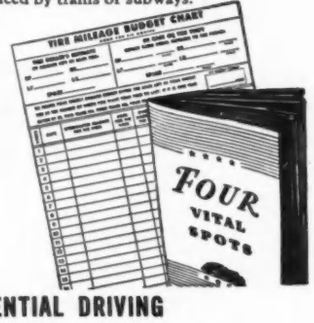
Buses can't do it ALONE. They're already taxed to their full seating capacity. And enough vital steel and rubber can't be spared to build enough new buses.

Trains can't do it ALONE. Although every railroad is cooperating 100%, many of America's mighty war production plants can't be serviced by trains or subways.

HOW TO CONSERVE MECHANICAL RUBBER GOODS
This 48-page book is for managers, engineers and plant operating men. It shows how you can conserve rubber through proper handling, installation and care of rubber conveyor, elevator and transmission belts; all types of industrial hose; packings; linings; rolls; mountings; and other mechanical rubber goods; and electrical wires, cables, and tapes. For free copies, write directly to Mechanical Goods Division, United States Rubber Company.



GET FREE MILEAGE BUDGET CHARTS
and copies of this free 32-page book on tire care from your local U. S. Tire Dealer or write direct to the United States Rubber Company. Hundreds of thousands of these charts and books are already in the hands of American car owners — helping to save tires, gas and oil.



IN AMERICA'S FIGHT FOR LIFE, EVERY TIRE-MILE MUST BE SAVED FOR ESSENTIAL DRIVING

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue • Rockefeller Center • New York

unit pressures of 60,000 psi at zero velocity. Another, called super-Oilite 16, will handle unit pressures of the order of 150,000 psi at zero velocity.

Typical of the broad range of parts made by Amplex is the following list:

Levers, cross heads, cams, automotive splined jack nuts, brackets, Gyrator gear sets, striker plates, dove tails, anti-friction bearing retainers, glands, vanes, rotors, thrust plates, blocks, large rest plates, jaws, parts with external and/or internal splines, indexing discs for dividing heads, etc.

In addition, Amplex has developed a technique for producing cored and bar stock for bushings, in a wide range of lengths and diameters.

The foregoing gives some impression of the extent to which the powder technique has been turned to the manufacture of many familiar items formerly made by other processes. Doubtless the list could be greatly extended by drawing upon the experiences of the other leading producers such as the Johnson Bronze Co. and Bound Brook Oil-Less Bearing Co.

As a matter of general interest it may be observed that many well-known producers in other fields, also are specialists in powder metallurgy. For example, P. R. Mallory, Inc., one of the largest producers of ignition contact points, welding electrodes, and other metallurgical specialties in rare metals, has practiced powder metallurgy for a great many years and is recognized as a leader in research in this field. Similarly, the suppliers of cemented-carbides — Carboloy, Ramet, Firth-Sterling, McKenna, and others, all produce these hard cutting tool materials from pure powder mixtures which are pressed and sintered. These examples are cited simply to indicate the extent to which the technique permeates many related activities of direct interest to the automotive industry.

Although space does not permit of a full discussion of the character of the mechanical parts noted above, it is important to appreciate that in every instance the new method has provided a means of reducing prime costs. In the case of the iron pump gears the savings include not only a major reduction in machining operations but a saving in materials cost as well. Similarly, the formation of intricately formed pieces such as cams or pawls, etc., holds tremendous possibilities of cast saving by the elimination of slow and expensive machining operations. In this respect, the powder process may be compared to the economies offered by the die-casting process.

We believe that the list of current applications mentioned elsewhere suffices to provide a clue as to what is being done, and to establish a base from which further progress can be made. Since full particulars may be readily obtained from the suppliers, we urge our readers to consult with the experts on any specific ideas that appear to be worth commercial exploration.

"Also in the purchase of new equipment and tools

MOTOR AGE

has been a big help, as we know practically all of the most reliable manufacturers are represented in Motor Age. We can keep well posted on their products and be in a position to make the best buys in this way."

The above, of course, is taken from a letter written to us by a MOTOR AGE subscriber. He is typical of thousands of other Motor Age subscribers in that he uses this leading automotive service magazine as a buying guide.

MOTOR AGE

A CHILTON Publication

Chestnut and 56th Sts. Philadelphia, Pa.

MEN

(*Continued from page* 58)

W. J. Maguire, formerly production manager, has been made works manager of the Chrysler-Jefferson plant and **A. P. Callies** has been named general superintendent of the Chrysler Division gun parts plant.

Johnson S. Davis and **G. A. Shallberg, Jr.,** have been named members of the newly created advertising department of Borg-Warner Corp. at Chicago. Fred H. Lockwood has resigned as publicity director.

H. B. Rose, formerly superintendent of the Indianapolis Works of International Harvester Co., has been named superintendent of the Springfield (Ohio) Works. **H. E. Gottberg,** formerly assistant superintendent of the Springfield Works, becomes acting superintendent of the Indianapolis Works. **William Dever,** corporation attorney, has been named manager of the new Ordnance Planning Division.

Thomas L. Baggs, of New York, has been appointed chief of the Truck Section of the Automotive Branch, War Production Board. He has been associated with the automotive industry for the past 20 years and at one time was on the personal staff of Walter P. Chrysler. He has been with the government for the last 16 months.

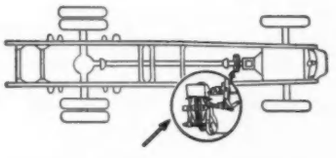
B. C. Gould has been appointed assistant to the president of Murray Corp. of America. He formerly was a partner in the management engineering firm of Stevenson, Jordan & Harrison. **Charles H. Widman,** vice-president in charge of sales, has retired from that position although he will devote some time to the promotion of special products.

TRU•STOP *Emergency* BRAKES SIGN UP FOR THE DURATION

We are giving all we've got to total war.

Thousands of **TRU-STOP** *Emergency* **BRAKES** already veterans in the service of America, are being reinforced by a surging flow of **TRU-STOPS** even more able to give a magnificent account of themselves in action. This flow shall continue until the day of Victory and Peace.

When that day comes you again may have **TRU-STOPS** on your equipment—**TRU-STOPS** that have met the demand of our armed forces for the most efficient emergency brake. That demand must be, and is being, met because speed is no more important to war equipment than is the ability of its emergency brakes to bring that equipment to safe, smooth stops from *any* vehicle speed—under all emergency conditions. And it is just as vital that these brakes hold their peak efficiency with absolutely minimum service.



TRU-STOP *Emergency* **BRAKES**

TRU-STOPS are manually-operated propeller shaft emergency brakes of disc type. Rugged discs are ventilated. A flow of air is driven across both discs by vane construction that rivals the efficiency of well-made pressure pumps —dissipating the heat of braking that destroys the linings of other brakes—adding immeasurably to lining life and making possible the continuous use of the emergency brake to supplement and save the service brakes.

TRU•STOP *Emergency* BRAKES

AUTOMOTIVE and AIRCRAFT DIVISION • **6-235 General Motors Building, Detroit** • **695 Bryant Street, San Francisco**

In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT • CONNECTICUT

Buick's Warplane Engine Plant

(*Continued from page* 27)

it possible to utilize the energy developed during the engine test process as the prime source of power for the entire plant. Consequently, the plant layout and plant equipment all have been designed for electric power exclusively —for fluorescent lighting, for machine drives, for electrically fired heat treating equipment, for washers and degreasers, for plating equipment, etc. As a matter of fact, the amount of potential energy from the test cell power house is expected to exceed the plant demand by a large margin, thus making it expedient to shunt excess power to the lines of the local public utility.

The test cell department is served by a basement gallery as well as by equipment on the roof. The basement gallery is designed to provide the test cell engines with filtered air under precise temperature and pressure conditions. To this end, the gallery space is sealed and insulated, and is swept by filtered air fed from a separate air-conditioning department. Air temperature is controlled thermostatically so as to feed air at the carburetor at 85 deg. Fahr.

Generally speaking, the routine test schedule is operated with oil taken from a central storage tank and recirculated continually. After each use, the oil stream goes through Sharples Super-Centrifuges to remove all physical impurities, then returns to the storage tank. It is of interest to find that the storage tank supply is checked at regular intervals for acidity. Just as soon as the acid number reaches a predetermined value, the oil is dumped and replaced by a fresh supply.

To conserve equipment time, test cell procedure has been expedited by the development of portable stands on which the engines are assembled in the gallery directly outside of the cells. Thus, it is possible to assemble the test stand set-up in the aisle while another engine is under test. Just as soon as one engine has been tested, it is moved out of the test cell together with the test stand, and a fresh engine then is ready to take its place. The test stands are moved about by means of an overhead craneway.

Perhaps one of the most important features of the testing facilities is the protection offered by a comprehensive Cardox system of fire extinguishment. The test cells themselves are equipped for automatic operation so that in the case of fire when unattended, carbon dioxide is automatically discharged into the test cell to a concentration sufficient to assure complete extinguishment. This automatic operation is supplemented by manual control at the operator's desk which provides facility for immediate application of carbon dioxide when fire is observed. Supplementing this protection against test cell fire is a separate line which leads to the carburetor for separate automatic treatment of internal engine fires not observable by the operator. The fan rooms above the test cells receive carbon dioxide simultaneously with the test cells and separate thermostats located in the fan rooms are provided. The basement areas containing blowers and miscellaneous equipment for serving the test cells are automatically protected with the automatic features supplemented by manual control. Similar automatic and/or manual treatment is provided for each control room.

The propeller test house, the single cylinder test, the carburetor flow bench, and the pump house are all protected by the Cardox system automatically and/or manually. Several hose reels are orderly spaced along the preparation corridor to provide complete Cardox protection in this area. Similarly, the dynamometer room containing all the dynamometers associated with the test cells is protected by hose reels. All the areas mounted are served by one central 8-ton Cardox storage unit which provides a sufficient reserve to take care of a multiplicity of fires should they occur simultaneously or consecutively.

KENNAMETAL SPEEDS
Victory PRODUCTION
KENNAMETAL
THE All American CARBIDE
STYLE 2
STYLE 1
STYLE 6
STYLE 3
STYLE 9
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STYLE 12
STYLE 15
On old machines or new . . . on steels of hardnesses up to 500 Brinell, KENNAMETAL tools permit machining speeds 2 to 6 times greater than are possible with high speed steel tools. In addition, KENNAMETAL removes 3 to 10 times more metal between regrinds, and often combines roughing and finishing in one cut.
These KENNAMETAL advantages add up to MORE guns, planes, tanks and ships. That's why it's important NOW to put KENNAMETAL in your tool rest.
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